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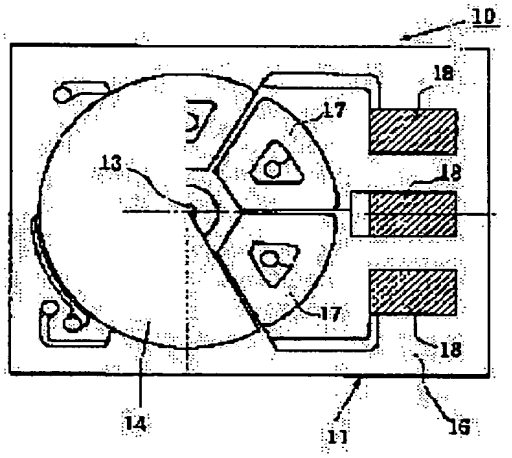
(54) SMALL SIZE MOTOR

(57)Abstract:
PURPOSE: To provide a small size motor in which drive coils are formed in small sizes with high precision and which can obtain a sufficient motor torque.
CONSTITUTION: A small size motor 10 has a stator board 16 which is fixed and has drive coils 17 at least on one of its surfaces and a disc rotor 14 which is supported to rotate freely and to face the stator board 16 and is so magnetized as to have a plurality of poles. In the small size motor like this, the drive coils 17 are composed of a plurality of pattern layers formed on one of the surfaces of the stator board by a photolithography method.



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CLAIMS

[Claim(s)]
[Claim 1] The small motor characterized by to be formed with the pattern of two or more layers which has disc-like Rota equipped with the magnet which counters the stator substrate with which it is placed in a fixed position, and the coil for a drive is prepared in one [at least] field, and this stator substrate, and is supported pivotable, and is magnetized by the multi-electrode, and by which the above-mentioned coil for a drive was formed in the whole surface of the above-mentioned stator substrate by the photolithography method in the small motor.
[Claim 2] The small motor according to claim 1 by which the pattern of the above-mentioned two or more layers is characterized by carrying out connection mutually as one group.
[Claim 3] The small motor according to claim 1 by which the pattern of the above-mentioned two or more layers is divided into two or more groups, and each group's pattern is characterized by carrying out connection mutually.
[Claim 4] The small motor according to claim 3 by which one group's pattern is characterized by being used for location detection and/or speed detection among two or more above-mentioned groups' patterns.
[Claim 5] A small motor given in any of claims 1-4 which are characterized by forming the York layer for a magnetic-path configuration on the above-mentioned stator substrate they are.
[Claim 6] The small motor given in any of claims 1-5 they are by which the pattern formed on the above-mentioned stator substrate is characterized by consisting of the magnetic substance.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the small motor which has a stator substrate, disc-like Rota, and the coil for a drive arranged by this stator substrate.
[0002]
[Description of the Prior Art] Conventionally, such a small motor is constituted as shown in drawing 16 . That is, in drawing 16 , the small motor 1 consists of the flat stator 2, bearing 3a and 3b prepared near the core of this stator 2, a revolving shaft 4 supported by this bearing 3a and 3b pivotable, and Rota 5 fixed to this revolving shaft 4.
[0003] It consists of oil impregnation metal, lubricative resin, etc. so that this bearing 3a may support a revolving shaft 4 in the direction of a path, and bearing 3b is constituted as thrust bearing so that a revolving shaft may be supported to shaft orientations.
[0004] Above-mentioned Rota 5 has annular Rota magnet 5a attached in the inferior surface of tongue while being arranged so that the whole surface (in the case of illustration top face) of a stator 2 may be countered.
[0005] Here, multi-electrode magnetization of the Rota magnet 5a is carried out so that N pole and the south pole may be located in a line by turns along with a circumferencial direction.
[0006] On the other hand, the stator 2 is equipped with stator substrate 2b laid on base 2a. This stator substrate 2b has circuit elements, such as two or more coils 6 for a drive arranged by the equiangular distance along with the circumferencial direction, and a hall device which is not illustrated, resistance, a capacitor, so that each magnetic pole of this Rota magnet 5a may be countered, while being formed by the griddle, the magnetic steel sheet, etc. so that it may act as fixed York for example.
[0007] Thus, according to the constituted small motor 1, the field generated in this coil 6 for a drive acts to N poles each and the south pole of Rota magnet 5a by energizing to each coil 6 for a drive on stator substrate 2b, respectively. Thereby, Rota 5 carries out a rotation drive around a revolving shaft 4.
[0008]
[Problem(s) to be Solved by the Invention] By the way, downsizing and miniaturization are advanced in all the goods fields in recent years, and the request of a miniaturization and thin-shape-izing is becoming still stronger also about the small motor used as a driving source of various devices.
[0009] Therefore, in miniaturizing, in the above small motors 1, thin shape-ization of the coil 6 for a drive is especially needed. for this reason, in order to produce the thin coil for a drive, the coil was really fabricated at the resin base — flexible — a printed coil — it is possible to use a product.
[0010] However, this flexible printed coil needs to form the coil for a drive in both sides of the resin base with an electric conduction pattern, when it thin-shape-izes more, but in forming the coil for a drive in both sides, it is in the middle of manufacture, and it is necessary to reverse the resin base. Therefore, there is a problem that positioning of the coil for a drive to both sides of the resin base becomes difficult.

[0011] On the other hand, when forming the coil for a drive only in the whole surface of the resin base, from the point of the width of face of an electric conduction pattern, the number of turns of the coil for a drive will decrease, and motor torque will fall. Moreover, when the electric conduction pattern was made detailed, the electric resistance of an electric conduction pattern increased, the current which flows the coil for a drive decreased, and there was a problem that motor torque will fall.
[0012] This invention aims at offering the small motor by which sufficient motor torque was acquired while the coil for a drive is formed small and with high precision in view of the above point.
[0013]
[Means for Solving the Problem] The stator substrate with which the above-mentioned purpose is placed in a fixed position according to this invention, and the coil for a drive is prepared in one [at least] field, In the small motor which has disc-like Rota equipped with the magnet which counters this stator substrate, and is supported pivotable, and is magnetized by the multi-electrode The above-mentioned coil for a drive is attained by the small motor characterized by being formed with the pattern of two or more layers formed in the whole surface of the above-mentioned stator substrate by the photolithography method.
[0014] The small motor by this invention is desirable, and connection of the pattern of the above-mentioned two or more layers is mutually carried out as one group.
[0015] The small motor by this invention is desirable, the pattern of the above-mentioned two or more layers is divided into two or more groups, and connection of each group's pattern is carried out mutually.
[0016] The small motor by this invention is desirable, and one group's pattern is used among two or more above-mentioned groups' patterns for location detection and/or speed detection.
[0017] The small motor by this invention is desirable, and the York layer for a magnetic-path configuration is formed on the above-mentioned stator substrate.
[0018] The small motor by this invention is desirable, and the pattern formed on the above-mentioned stator substrate consists of the magnetic substance.
[0019]
[Function] Since the coil for a drive is formed in the whole surface of a stator substrate from the pattern of two or more layers formed by the photolithography method, while it is thin-shape-ized very much by it as compared with a flexible printed coil according to the above-mentioned configuration, close dimensional accuracy and positioning accuracy will be acquired very much about the pattern which constitutes the coil for a drive.
[0020] When connection of the pattern of the above-mentioned two or more layers is mutually carried out as one group and the number of turns of the coil for a drive is the same, it is possible to make width of face of each pattern large, and coil resistance is reduced. Therefore, more drive currents can be passed in the coil for a drive.
[0021] When the pattern of the above-mentioned two or more layers is divided into two or more groups and connection of each group's pattern is carried out mutually, resistance becomes possible [constituting two or more sets of coils for a drive which can be reduced sharply].
[0022] Since induced voltage occurs to this group's pattern with rotation of Rota when one group's pattern is used among two or more above-mentioned groups' patterns for location detection and/or speed detection, this induced voltage is detected, it processes suitably, and location detection and/or rotational-speed detection of Rota are performed.
[0023] When the York layer for a magnetic-path configuration is formed on the above-mentioned stator substrate, the magnetic flux of the Rota magnet will pass this York layer, and a flux linkage with the coil for a drive increases. Therefore, the magnetic flux of the Rota magnet will be used further effectively.
[0024] Since the coil for a drive is the magnetic substance and the magnetic flux of the Rota magnet can be brought together in this pattern when the pattern formed on the above-mentioned stator substrate consists of the magnetic substance, generating torque increases.
[0025]
[Example] Hereafter, the suitable example of this invention is explained to a detail, referring to

drawing 1 thru/or drawing 15 . In addition, since the example described below is a suitable example of this invention, desirable various limitation is attached technically, but especially the range of this invention is not restricted to these modes, as long as there is no publication of the purport which limits this invention in the following explanation.

[0026] Drawing 1 and drawing 2 show the first example of the small motor by this invention. That is, in drawing 1 and drawing 2 , the small motor 10 consists of the flat stator 11, bearing 12 with which the lower part of bearing 11a formed near the core of this stator 11 was equipped, a revolving shaft 13 supported by this bearing 11a and bearing 12 pivotable, and Rota 14 fixed to this revolving shaft 13.

[0027] It is constituted as thrust bearing so that the above-mentioned bearing 11a may support a revolving shaft 13 in the direction of a path and bearing 12 may support a revolving shaft to shaft orientations.

[0028] Above-mentioned Rota 14 has annular Rota magnet 14a with which the inferior surface of tongue was equipped while being arranged so that the whole surface (in the case of illustration top face) of a stator 11 may be countered. In illustration, it is constituted by another object and fixed to the inferior surface of tongue of Rota 14, but this Rota magnet 14a may be directly formed of the spatter etc. to the inferior surface of tongue of Rota 14. Moreover, Rota 14 may be formed in a revolving shaft 13 and one.

[0029] Here, multi-electrode magnetization of the Rota magnet 14a is carried out so that N pole and the south pole may be located in a line by turns along with a circumferencial direction.

[0030] On the other hand, the stator 11 is equipped with the stator substrate 16 laid on the base 15. As this stator substrate 16 is shown in drawing 3 , the coil 17 for a drive and the electrode 18 grade are formed in that front face by the photolithography method. Here, in order that this stator 11 may increase the magnetic flux interlinked in the coil 17 for a drive so that the magnetism of Rota magnet 14a may be used effectively, it will act as York for magnetic-path formation by forming the field which the base 15 is formed from the magnetic substance, or counters the whole stator substrate 16 or Rota magnet 14a preferably from the magnetic substance.

[0031] In drawing 3 , the formation process of the coil 17 for a drive to the stator substrate 16 and electrode 18 grade is explained one by one. The first insulating layer 20 is formed in the front face of the stator substrate 16 in point ** and a process 1. in this case, formation of an insulating layer 20 — for example, SiO2 Si3 N4 etc. — using it — PVD (Pysical Vapor Deposition) — law and CVD (Chemical Vapor Deposition) — it is performed by law etc. and resin coating. Moreover, when the oxide of an ingredient is an insulator like Si substrate in the stator substrate 16, an insulating layer 20 is formed by heating the stator substrate 16 to an elevated temperature in an oxidizing atmosphere.

[0032] Then, in a process 2, the first conductive layer 21 which should serve as a coil for a drive and a connection pattern is formed on an insulating layer 20. In this case, a conductive layer 21 forms conductors, such as copper, aluminum, gold, and nickel, by PVD, plating, etc.

[0033] Next, in a process 3, from on the first conductive layer 21, the photoresist 22 which is a giant-molecule resin ingredient is applied, and at a process 4, the first photo mask 30 shown in drawing 4 is used, and it is exposed. In this case, like illustration, the first photo mask 30 is constituted so that it may have window parts 30a, 30b, and 30c, respectively into the parts of some coils 17 for a drive, a connection pattern, and an electrode 18.

[0034] And in a process 5, the unexposed excessive photoresist 22 is removed by washing etc. and the part of the first conductive layer 21 exposed by removal of a photoresist 22 is removed by etching in a process 6. Then, at a process 7, the solvent which does not act on the first insulating layer 20 of the above and the first conductive layer 21 is used, and the residual photoresist 22 is removed. The first electric conduction pattern 23 which should constitute the part, connection pattern, and electrode 18 of the coil 17 for a drive which has a predetermined pattern in this way is formed.

[0035] Then, in a process 8, the second insulating layer 24 is formed in the whole front face of the stator substrate 16 so that this first electric conduction pattern 23 may be covered.

[0036] And in a process 9, the second photo mask 31 shown in drawing 5 is used, and window

part 24a for energization is formed to this second insulating layer 24. In this case, as shown in drawing 5 , the second photo mask 31 is constituted so that it may have window parts 31a and 31b, respectively into the connection terminal area of each coil for a drive of the first electric conduction pattern 23, and the part of an electrode 18.

[0037] Next, in a process 10, the third photo mask 32 shown in drawing 6 is used, and the second electric conduction pattern 25 is formed from on the second insulating layer 24 by the same procedure as the process 2 thru/or process 7 mentioned above. In this case, like illustration, the third photo mask 32 is constituted so that it may have window parts 32a, 32b, and 32c, respectively into the parts of some coils 17 for a drive, a connection pattern, and an electrode 18.

[0038] Then, in a process 11, from on the second electric conduction pattern 25, in order to prevent the pattern short-circuit by adhesion of conductive dust, and oxidation of a conductive layer, the third insulating layer 26 for pattern protection is formed so that the whole front face of the stator substrate 16 may be covered.

[0039] Finally in a process 12, the fourth photo mask 33 shown in drawing 7 is used, and window part 26a for electric supply is formed to the third insulating layer 26. In this case, the fourth photo mask 33 is constituted so that it may have window part 33a into the first and second parts of the electrode 18 of the electric conduction patterns 23 and 25.

[0040] In this way, connection is carried out as six coils show the coil 17 for a drive of each other constituted with the first electric conduction pattern 23 and the second electric conduction pattern 25 to drawing 8 , respectively in the plurality by the coil pattern of the first electric conduction pattern 23 which laps up and down, and the second electric conduction pattern 25, and illustration. While the coil for a drive mutually located in the radial opposite side by this is connected to a serial A side besides one coil for a drive will be mutually connected among the coils for a drive of each phase of the three phase connected to the serial, i.e., U phase, V phase, and W phase, and a side besides the coil for a drive of another side will be connected to one of the electrodes 18, respectively, and the coil 17 for a drive of a three phase is constituted.

[0041] The small motor 10 by this example is constituted as mentioned above, and as drawing 1 and drawing 2 show, the field generated in this coil 17 for a drive acts to N poles each and the south pole of Rota magnet 14a by energizing from an electrode 18 to each coil 17 for a drive on the stator substrate 16, respectively. Thereby, Rota 14 carries out a rotation drive around a revolving shaft 13.

[0042] Since the coil 17 for a drive is formed in the whole surface of the stator substrate 16 from the patterns 23 and 25 of two or more layers formed by the photolithography method one by one, while it is thin-shape-ized very much by it as compared with a flexible printed coil according to this example, close dimensional accuracy and positioning accuracy will be acquired very much about the pattern which constitutes the coil 17 for a drive. Therefore, property degradation of the motor produced by the precision fall at the time of manufacture decreases extremely. Moreover, since these patterns 23 and 25 are formed of conductor layers, such as copper, aluminum, gold, and nickel, they will consist of low resistance minutely.

[0043] Since the coil 17 for a drive is formed with the patterns 23 and 25 of two or more layers as compared with what followed, for example, formed the coil for a drive superficially with the electric conduction pattern on the conventional stator substrate when the number of turns of the coil 17 for a drive was the same according to this example, it is possible to make large width of face of each patterns 23 and 25, and coil resistance is reduced. Therefore, since more drive currents can be passed in the coil for a drive, generating torque will increase.

[0044] Moreover, since the number of coil turns can be made [more] when coil resistance is made the same, generating torque will increase similarly. Furthermore, it is not necessary to paste up or to solder the coil 17 for a drive like before, for electrical installation. Moreover, mass production also becomes possible by forming the pattern of a lot of coils for a drive at once like the case of manufacture of a semiconductor device on the base of a big stator, and cutting to each stator substrate afterwards. Therefore, working efficiency will be raised and cost will also be reduced.

[0045] By the way, in the above-mentioned example, the coil 17 for a drive consists of the 1 group's A coils which consisted of the first electric conduction pattern 23 and the second electric conduction pattern 25 which were formed by the photolithography method on the stator substrate 16. And as shown in drawing 9 , after forming the first group's A coil on the stator substrate 16, the second group's B coil is formed on the first group's A coil by repeating the processes 2-12 of drawing 3 . In this case, since it connects mutually and connects with an electrode 18 like the first group A who also shows each coil of the second group B to drawing 8 , the first group A and the second group B will be connected as shown in drawing 10 as a whole.
[0046] Here, as each coil of each phase, i.e., U phase, V phase, and W phase is shown in the equal circuit of drawing 11 , two coils, the first group each other connected to a serial, respectively and the second group, will be further connected to juxtaposition. Thereby, the coil in each phase becomes half resistance as compared with the case where it is shown in drawing 8 . Therefore, according to the coil for a drive equipped with the coil of the first group A and the second group B by which the laminating was carried out, even if it narrows width of face of a pattern and makes [many] the number of turns, coil resistance will be pushed low and big torque will be acquired by that of ********.
[0047] Moreover, when it has the coil of the first group A and the second group B by which the laminating was carried out as mentioned above, the first group A is connected to an electrode 18 like the case of drawing 8 . As it uses as a coil for a drive and the second group B is connected to electrode with an another electrode 18, you may make it detect the induced voltage generated in the second group B with rotation of Rota 14 by using this another electrode as a detection electrode. In this case, rotation location detection and/or rotational-speed detection of Rota 14 are performed by detecting the electrical potential difference generated in the second group B.
[0048] Furthermore, since this second group's B pattern is detailed, rotation location detection and/or rotational-speed detection of Rota 14 are more highly precise, and are performed. And since this second group's B pattern is arranged corresponding to the perimeter of Rota 14, full-time detection is also attained.
[0049] Drawing 12 shows the second example of the small motor by this invention. That is, in drawing 12 , the small motor 40 consists of the flat stator 41, bearing 42 with which the lower part of bearing 41a formed near the core of this stator 41 was equipped, a revolving shaft 43 supported by this bearing 41a and bearing 42 pivotable, and Rota 44 fixed to this revolving shaft 43.
[0050] It is constituted as thrust bearing so that the above-mentioned bearing 41a may support a revolving shaft 43 in the direction of a path and bearing 42 may support a revolving shaft to shaft orientations.
[0051] Above-mentioned Rota 44 has annular Rota magnet 44a with which the inferior surface of tongue was equipped while being arranged so that the whole surface (in the case of illustration top face) of a stator 41 may be countered. In illustration, it is constituted by another object and fixed to the inferior surface of tongue of Rota 44, but this Rota magnet 44a may be directly formed of the spatter etc. to the inferior surface of tongue of Rota 44. Moreover, Rota 44 may be formed in a revolving shaft 43 and one.
[0052] Here, multi-electrode magnetization of the Rota magnet 44a is carried out so that N pole and the south pole may be located in a line by turns along with a circumferencial direction.
[0053] On the other hand, the stator 41 is equipped with the stator yoke 46 which consists of the magnetic substance prepared on the base 45, and the stator substrate 47 formed on it. As this stator substrate 47 is shown in drawing 3 like the stator substrate 16 mentioned above, the coil 48 for a drive, the electrode (not shown), etc. are formed in that front face by the photolithography method.
[0054] In this case, since the base 45 and the stator substrate 47 of a stator 41 consist of non-magnetic material, they need to use the magnetism of Rota magnet 44a effectively, and need to increase the magnetic flux interlinked in the coil 47 for a drive. For this reason, the stator yoke 46 which consists of the magnetic substance is formed.
[0055] Moreover, you may make it the stator substrate 47 equip the bottom of the first

insulating layer 50 with a magnetic layer 49, as shown in drawing 13 instead of forming the above-mentioned stator yoke 46.
[0056] Here, formation processes, such as a magnetic layer to the stator substrate 47 in drawing 12 , the coil 48 for a drive, and an electrode, are explained one by one using drawing 13 . In point ** and a process 1, the magnetic layer 49 which acts on the front face of the stator substrate 47 as a back yoke is formed. Formation of this magnetic layer 49 is performed by PVD etc. in the magnetic substance, such as nickel and a soft ferrite. Next, the first insulating layer 50 is formed in the front face of the stator substrate 47 in a process 2. in this case, formation of an insulating layer 50 — for example, SiO2 Si3 N4 etc. — it is used and is performed by PVD, a CVD method, etc. and resin coating. Moreover, when the oxide of an ingredient is an insulator like Si substrate in the stator substrate 47, an insulating layer 50 may be formed by heating the stator substrate 47 to an elevated temperature in an oxidizing atmosphere.
[0057] Then, in a process 3, the first conductive layer 51 which should serve as a coil for a drive and a connection pattern is formed from on an insulating layer 50. In this case, a conductive layer 51 is formed of PVD, plating, etc. in conductors, such as copper, aluminum, gold, and nickel.

[0058] Next, in a process 4, from on the first conductive layer 51, the photoresist 52 which is a giant-molecule resin ingredient is applied, and at a process 5, the first photo mask 30 shown in drawing 4 is used, and it is exposed.
[0059] And in a process 6, the unexposed excessive photoresist 52 is removed by washing etc. and the part of the first conductive layer 51 exposed by removal of a photoresist 52 is removed by etching in a process 7. Then, at a process 8, the solvent which does not act on the first insulating layer 50 of the above and the first conductive layer 51 is used, and the residual photoresist 52 is removed. The first electric conduction pattern 53 which should constitute the part, connection pattern, and electrode of the coil 48 for a drive which has a predetermined pattern in this way will be formed.
[0060] Then, in a process 9, the second insulating layer 54 is formed in the whole front face of the stator substrate 47 so that this first electric conduction pattern 53 may be covered.
[0061] And in a process 10, the second photo mask 31 shown in drawing 5 is used, and window part 54a for energization is formed to this second insulating layer 54.
[0062] Next, in a process 11, the third photo mask 32 shown in drawing 6 is used, and the second electric conduction pattern 55 is formed from on the second insulating layer 54 by the same procedure as the process 3 thru/or process 8 mentioned above.
[0063] Then, in a process 12, from on the second electric conduction pattern 55, in order to prevent the pattern short-circuit by adhesion of conductive dust, and oxidation of a conductive layer, the third insulating layer 56 for pattern protection is formed so that the whole front face of the stator substrate 47 may be covered.
[0064] Finally in a process 13, the fourth photo mask 33 shown in drawing 7 is used, and window part 56a for electric supply is formed to the third insulating layer 56.
[0065] In this way, connection is carried out as six coils show the coil 48 for a drive of each other constituted with the first electric conduction pattern 53 and the second electric conduction pattern 55 to drawing 8 , respectively in the plurality by the coil pattern of the first electric conduction pattern 53 which laps up and down, and the second electric conduction pattern 55, and illustration. While the coil for a drive mutually located in the radial opposite side by this is connected to a serial A side besides one coil for a drive will be mutually connected among the coils for a drive of each phase of the three phase connected to the serial, i.e., U phase, V phase, and W phase, and a side besides the coil for a drive of another side will be connected to one of the electrodes 18, respectively, and the coil 47 for a drive of a three phase is constituted.
[0066] According to the small motor 40 of such a configuration, the field generated in this coil 47 for a drive acts to N poles each and the south pole of Rota magnet 44a by energizing from an electrode to each coil 47 for a drive on the stator substrate 47, respectively. Thereby, Rota 44 carries out a rotation drive around a revolving shaft 43.
[0067] Furthermore, when the magnetic layer 49 formed on the stator yoke 46 arranged in the

bottom of the stator substrate 47 or the stator substrate 47 acts as a back yoke, the magnetic flux of Rota magnet 44a will be used effectively. In addition, to the case of a magnetic layer 49, since the gap between a back yoke and rotary magnet 44a is more narrow, a flux linkage with the coil of Rota magnet 44a will increase further.

[0068] Like the stator substrate shown in drawing 9 also in this case, after forming the first group's A coil on the stator substrate 47, as shown in drawing 14 , the second group's B coil may be formed on the first group's A coil by repeating the processes 3–13 of drawing 13 .

[0069] Thereby, when two coils, the first group by whom each coil of each phase, i.e., U phase, V phase, and W phase is mutually connected to a serial, respectively, and the second group, are further connected to juxtaposition, the coil in each phase becomes half resistance as compared with the case of only the first group's A coil. Moreover, only the second group's B coil is connected to an electrode other than the electrode to which driver voltage is impressed, and by using this another electrode as a detection electrode, when detecting the induced voltage generated in the second group B with rotation of Rota 44, rotation location detection and/or rotational–speed detection of Rota 44 are performed, for example.

[0070] Drawing 15 shows the third example of the small motor by this invention. That is, in drawing 15 , the small motor 60 consists of the flat stator 61, bearing 62a and 62b which it had near the core of this stator 61, a revolving shaft 63 supported by this bearing 62a and 62b pivotable, and Rota 64 fixed to this revolving shaft 63.

[0071] It is constituted as thrust bearing so that the above–mentioned bearing 62a may support a revolving shaft 63 in the direction of a path and bearing 62b may support a revolving shaft to shaft orientations. The small motor 60 by this example is a different configuration in the small motor 10 which showed only the point of having this bearing 62a to drawing 1 and drawing 2 .

[0072] Above–mentioned Rota 64 has annular Rota magnet 64a with which the inferior surface of tongue was equipped while being arranged so that the whole surface (in the case of illustration top face) of a stator 61 may be countered. In illustration, it is constituted by another object and fixed to the inferior surface of tongue of Rota 64, but this Rota magnet 64a may be directly formed of the spatter etc. to the inferior surface of tongue of Rota 64. Moreover, Rota 64 may be formed in a revolving shaft 63 and one.

[0073] Here, multi–electrode magnetization of the Rota magnet 64a is carried out so that N pole and the south pole may be located in a line by turns along with a circumferencial direction.

[0074] On the other hand, the stator 61 is equipped with the stator substrate 66 laid on the base 65. As this stator substrate 66 is shown in drawing 3 , the coil 67 for a drive, the electrode (not shown), etc. are formed in that front face by the photolithography method. Here, in order that this stator 61 may increase the magnetic flux interlinked in the coil 67 for a drive so that the magnetism of Rota magnet 64a may be used effectively, it will act as York for magnetic–path formation by forming the field which the base 65 is formed from the magnetic substance, or counters the whole stator substrate 66 or Rota magnet 64a preferably from the magnetic substance.

[0075] According to the small motor 60 of such a configuration, the field generated in this coil 67 for a drive acts to N poles each and the south pole of Rota magnet 64a by energizing from an electrode to each coil 67 for a drive on the stator substrate 66, respectively. Thereby, Rota 64 carries out a rotation drive around a revolving shaft 63.

[0076] Here, since the coil 67 for a drive on the stator substrate 66 is formed by the photolithography method, its dimensional accuracy and positioning accuracy of a coil coil are very high, therefore its property degradation of the motor produced by the precision fall at the time of manufacture decreases extremely. Moreover, since the mutual connection of the coil 67 for a drive and the connection to an electrode are formed in the coil 67 for a drive, and coincidence by the photolithography method and adhesion of a up to [the stator substrate 66 of the coil 67 for a drive] and the soldering activity over the electrode of a coil coil terminal are unnecessary, working efficiency will improve and assembly cost will be reduced sharply.

[0077] In this case, since the coil 67 for a drive is constituted by the pattern of the bilayer of the first electric conduction pattern 23 and the second electric conduction pattern 25, as compared with the case of a flexible printed coil, the width of face of a pattern is formed widely

conventionally. Therefore, since coil resistance is reduced, it is possible to pass a big drive current. For this reason, sufficient torque will be acquired.

[0078] In addition, in the above-mentioned example, although the coil for a drive consists of coils of one group or two groups by whom the laminating was done, not only this but the coil for a drive may consist of two or more groups' coils by carrying out the laminating of the third and fourth group's coil further. By this, when each group's coil is mutually connected to juxtaposition, the combined-resistance value of a coil will be reduced further.

[0079] Moreover, rotation location detection and/or rotational-speed detection of Rota 64 may be made to be performed by connecting only the coil of one group in two or more groups' coil to another electrode, and detecting the induced voltage generated in the coil of groups involved.

[0080]

[Effect of the Invention] As stated above, while being formed small [the coil for a drive], and with high precision according to this invention, the extremely excellent small motor by which sufficient motor torque was acquired will be offered.

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TECHNICAL FIELD

[Industrial Application] This invention relates to the small motor which has a stator substrate, disc-like Rota, and the coil for a drive arranged by this stator substrate.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Conventionally, such a small motor is constituted as shown in drawing 16 . That is, in drawing 16 , the small motor 1 consists of the flat stator 2, bearing 3a and 3b prepared near the core of this stator 2, a revolving shaft 4 supported by this bearing 3a and 3b pivotable, and Rota 5 fixed to this revolving shaft 4.
[0003] It consists of oil impregnation metal, lubricative resin, etc. so that this bearing 3a may support a revolving shaft 4 in the direction of a path, and bearing 3b is constituted as thrust bearing so that a revolving shaft may be supported to shaft orientations.
[0004] Above-mentioned Rota 5 has annular Rota magnet 5a attached in the inferior surface of tongue while being arranged so that the whole surface (in the case of illustration top face) of a stator 2 may be countered.
[0005] Here, multi-electrode magnetization of the Rota magnet 5a is carried out so that N pole and the south pole may be located in a line by turns along with a circumferencial direction.
[0006] On the other hand, the stator 2 is equipped with stator substrate 2b laid on base 2a. This stator substrate 2b has circuit elements, such as two or more coils 6 for a drive arranged by the equiangular distance along with the circumferencial direction, and a hall device which is not illustrated, resistance, a capacitor, so that each magnetic pole of this Rota magnet 5a may be countered, while being formed by the griddle, the magnetic steel sheet, etc. so that it may act as fixed York for example.
[0007] Thus, according to the constituted small motor 1, the field generated in this coil 6 for a drive acts to N poles each and the south pole of Rota magnet 5a by energizing to each coil 6 for a drive on stator substrate 2b, respectively. Thereby, Rota 5 carries out a rotation drive around a revolving shaft 4.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] As stated above, while being formed small [the coil for a drive], and with high precision according to this invention, the extremely excellent small motor by which sufficient motor torque was acquired will be offered.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, downsizing and miniaturization are advanced in all the goods fields in recent years, and the request of a miniaturization and thin-shape-izing is becoming still stronger also about the small motor used as a driving source of various devices.
[0009] Therefore, in miniaturizing, in the above small motors 1, thin shape-ization of the coil 6 for a drive is especially needed. for this reason, in order to produce the thin coil for a drive, the coil was really fabricated at the resin base — flexible — a printed coil — it is possible to use a product.
[0010] However, this flexible printed coil needs to form the coil for a drive in both sides of the resin base with an electric conduction pattern, when it thin-shape-izes more, but in forming the coil for a drive in both sides, it is in the middle of manufacture, and it is necessary to reverse the resin base. Therefore, there is a problem that positioning of the coil for a drive to both sides of the resin base becomes difficult.
[0011] On the other hand, when forming the coil for a drive only in the whole surface of the resin base, from the point of the width of face of an electric conduction pattern, the number of turns of the coil for a drive will decrease, and motor torque will fall. Moreover, when the electric conduction pattern was made detailed, the electric resistance of an electric conduction pattern increased, the current which flows the coil for a drive decreased, and there was a problem that motor torque will fall.
[0012] This invention aims at offering the small motor by which sufficient motor torque was acquired while the coil for a drive is formed small and with high precision in view of the above point.

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MEANS

[Means for Solving the Problem] The stator substrate with which the above-mentioned purpose is placed in a fixed position according to this invention, and the coil for a drive is prepared in one [at least] field, In the small motor which has disc-like Rota equipped with the magnet which counters this stator substrate, and is supported pivotable, and is magnetized by the multi-electrode The above-mentioned coil for a drive is attained by the small motor characterized by being formed with the pattern of two or more layers formed in the whole surface of the above-mentioned stator substrate by the photolithography method.
[0014] The small motor by this invention is desirable, and connection of the pattern of the above-mentioned two or more layers is mutually carried out as one group.
[0015] The small motor by this invention is desirable, the pattern of the above-mentioned two or more layers is divided into two or more groups, and connection of each group's pattern is carried out mutually.
[0016] The small motor by this invention is desirable, and one group's pattern is used among two or more above-mentioned groups' patterns for location detection and/or speed detection.
[0017] The small motor by this invention is desirable, and the York layer for a magnetic-path configuration is formed on the above-mentioned stator substrate.
[0018] The small motor by this invention is desirable, and the pattern formed on the above-mentioned stator substrate consists of the magnetic substance.

[Translation done.]

OPERATION

[Function] Since the coil for a drive is formed in the whole surface of a stator substrate from the pattern of two or more layers formed by the photolithography method, while it is thin-shape-ized very much by it as compared with a flexible printed coil according to the above-mentioned configuration, close dimensional accuracy and positioning accuracy will be acquired very much about the pattern which constitutes the coil for a drive.
[0020] When connection of the pattern of the above-mentioned two or more layers is mutually carried out as one group and the number of turns of the coil for a drive is the same, it is possible to make width of face of each pattern large, and coil resistance is reduced. Therefore, more drive currents can be passed in the coil for a drive.
[0021] When the pattern of the above-mentioned two or more layers is divided into two or more groups and connection of each group's pattern is carried out mutually, resistance becomes possible [constituting two or more sets of coils for a drive which can be reduced sharply].
[0022] Since induced voltage occurs to this group's pattern with rotation of Rota when one group's pattern is used among two or more above-mentioned groups' patterns for location detection and/or speed detection, this induced voltage is detected, it processes suitably, and location detection and/or rotational-speed detection of Rota are performed.
[0023] When the York layer for a magnetic-path configuration is formed on the above-mentioned stator substrate, the magnetic flux of the Rota magnet will pass this York layer, and a flux linkage with the coil for a drive increases. Therefore, the magnetic flux of the Rota magnet will be used further effectively.
[0024] Since the coil for a drive is the magnetic substance and the magnetic flux of the Rota magnet can be brought together in this pattern when the pattern formed on the above-mentioned stator substrate consists of the magnetic substance, generating torque increases.

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EXAMPLE

[Example] Hereafter, the suitable example of this invention is explained to a detail, referring to drawing 1 thru/or drawing 15 . In addition, since the example described below is a suitable example of this invention, desirable various limitation is attached technically, but especially the range of this invention is not restricted to these modes, as long as there is no publication of the purport which limits this invention in the following explanation.
[0026] Drawing 1 and drawing 2 show the first example of the small motor by this invention. That is, in drawing 1 and drawing 2 , the small motor 10 consists of the flat stator 11, bearing 12 with which the lower part of bearing 11a formed near the core of this stator 11 was equipped, a revolving shaft 13 supported by this bearing 11a and bearing 12 pivotable, and Rota 14 fixed to this revolving shaft 13.
[0027] It is constituted as thrust bearing so that the above-mentioned bearing 11a may support a revolving shaft 13 in the direction of a path and bearing 12 may support a revolving shaft to shaft orientations.
[0028] Above-mentioned Rota 14 has annular Rota magnet 14a with which the inferior surface of tongue was equipped while being arranged so that the whole surface (in the case of illustration top face) of a stator 11 may be countered. In illustration, it is constituted by another object and fixed to the inferior surface of tongue of Rota 14, but this Rota magnet 14a may be directly formed of the spatter etc. to the inferior surface of tongue of Rota 14. Moreover, Rota 14 may be formed in a revolving shaft 13 and one.
[0029] Here, multi-electrode magnetization of the Rota magnet 14a is carried out so that N pole and the south pole may be located in a line by turns along with a circumferencial direction.
[0030] On the other hand, the stator 11 is equipped with the stator substrate 16 laid on the base 15. As this stator substrate 16 is shown in drawing 3 , the coil 17 for a drive and the electrode 18 grade are formed in that front face by the photolithography method. Here, in order that this stator 11 may increase the magnetic flux interlinked in the coil 17 for a drive so that the magnetism of Rota magnet 14a may be used effectively, it will act as York for magnetic-path formation by forming the field which the base 15 is formed from the magnetic substance, or counters the whole stator substrate 16 or Rota magnet 14a preferably from the magnetic substance.
[0031] In drawing 3 , the formation process of the coil 17 for a drive to the stator substrate 16 and electrode 18 grade is explained one by one. The first insulating layer 20 is formed in the front face of the stator substrate 16 in point ** and a process 1. in this case, formation of an insulating layer 20 — for example, SiO2 Si3 N4 etc. — using it — PVD (Pysical Vapor Deposition) — law and CVD (Chemical Vapor Deposition) — it is performed by law etc. and resin coating. Moreover, when the oxide of an ingredient is an insulator like Si substrate in the stator substrate 16, an insulating layer 20 is formed by heating the stator substrate 16 to an elevated temperature in an oxidizing atmosphere.
[0032] Then, in a process 2, the first conductive layer 21 which should serve as a coil for a drive and a connection pattern is formed on an insulating layer 20. In this case, a conductive layer 21 forms conductors, such as copper, aluminum, gold, and nickel, by PVD, plating, etc.
[0033] Next, in a process 3, from on the first conductive layer 21, the photoresist 22 which is a

giant-molecule resin ingredient is applied, and at a process 4, the first photo mask 30 shown in drawing 4 is used, and it is exposed. In this case, like illustration, the first photo mask 30 is constituted so that it may have window parts 30a, 30b, and 30c, respectively into the parts of some coils 17 for a drive, a connection pattern, and an electrode 18.

[0034] And in a process 5, the unexposed excessive photoresist 22 is removed by washing etc. and the part of the first conductive layer 21 exposed by removal of a photoresist 22 is removed by etching in a process 6. Then, at a process 7, the solvent which does not act on the first insulating layer 20 of the above and the first conductive layer 21 is used, and the residual photoresist 22 is removed. The first electric conduction pattern 23 which should constitute the part, connection pattern, and electrode 18 of the coil 17 for a drive which has a predetermined pattern in this way is formed.

[0035] Then, in a process 8, the second insulating layer 24 is formed in the whole front face of the stator substrate 16 so that this first electric conduction pattern 23 may be covered.

[0036] And in a process 9, the second photo mask 31 shown in drawing 5 is used, and window part 24a for energization is formed to this second insulating layer 24. In this case, as shown in drawing 5 , the second photo mask 31 is constituted so that it may have window parts 31a and 31b, respectively into the connection terminal area of each coil for a drive of the first electric conduction pattern 23, and the part of an electrode 18.

[0037] Next, in a process 10, the third photo mask 32 shown in drawing 6 is used, and the second electric conduction pattern 25 is formed from on the second insulating layer 24 by the same procedure as the process 2 thru/or process 7 mentioned above. In this case, like illustration, the third photo mask 32 is constituted so that it may have window parts 32a, 32b, and 32c, respectively into the parts of some coils 17 for a drive, a connection pattern, and an electrode 18.

[0038] Then, in a process 11, from on the second electric conduction pattern 25, in order to prevent the pattern short-circuit by adhesion of conductive dust, and oxidation of a conductive layer, the third insulating layer 26 for pattern protection is formed so that the whole front face of the stator substrate 16 may be covered.

[0039] Finally in a process 12, the fourth photo mask 33 shown in drawing 7 is used, and window part 26a for electric supply is formed to the third insulating layer 26. In this case, the fourth photo mask 33 is constituted so that it may have window part 33a into the first and second parts of the electrode 18 of the electric conduction patterns 23 and 25.

[0040] In this way, connection is carried out as six coils show the coil 17 for a drive of each other constituted with the first electric conduction pattern 23 and the second electric conduction pattern 25 to drawing 8 , respectively in the plurality by the coil pattern of the first electric conduction pattern 23 which laps up and down, and the second electric conduction pattern 25, and illustration. While the coil for a drive mutually located in the radial opposite side by this is connected to a serial A side besides one coil for a drive will be mutually connected among the coils for a drive of each phase of the three phase connected to the serial, i.e., U phase, V phase, and W phase, and a side besides the coil for a drive of another side will be connected to one of the electrodes 18, respectively, and the coil 17 for a drive of a three phase is constituted.

[0041] The small motor 10 by this example is constituted as mentioned above, and as drawing 1 and drawing 2 show, the field generated in this coil 17 for a drive acts to N poles each and the south pole of Rota magnet 14a by energizing from an electrode 18 to each coil 17 for a drive on the stator substrate 16, respectively. Thereby, Rota 14 carries out a rotation drive around a revolving shaft 13.

[0042] Since the coil 17 for a drive is formed in the whole surface of the stator substrate 16 from the patterns 23 and 25 of two or more layers formed by the photolithography method one by one, while it is thin-shape-ized very much by it as compared with a flexible printed coil according to this example, close dimensional accuracy and positioning accuracy will be acquired very much about the pattern which constitutes the coil 17 for a drive. Therefore, property degradation of the motor produced by the precision fall at the time of manufacture decreases extremely. Moreover, since these patterns 23 and 25 are formed of conductor layers, such as

copper, aluminum, gold, and nickel, they will consist of low resistance minutely.
[0043] Since the coil 17 for a drive is formed with the patterns 23 and 25 of two or more layers as compared with what followed, for example, formed the coil for a drive superficially with the electric conduction pattern on the conventional stator substrate when the number of turns of the coil 17 for a drive was the same according to this example, it is possible to make large width of face of each patterns 23 and 25, and coil resistance is reduced. Therefore, since more drive currents can be passed in the coil for a drive, generating torque will increase.
[0044] Moreover, since the number of coil turns can be made [more] when coil resistance is made the same, generating torque will increase similarly. Furthermore, it is not necessary to paste up or to solder the coil 17 for a drive like before, for electrical installation. Moreover, mass production also becomes possible by forming the pattern of a lot of coils for a drive at once like the case of manufacture of a semiconductor device on the base of a big stator, and cutting to each stator substrate afterwards. Therefore, working efficiency will be raised and cost will also be reduced.
[0045] By the way, in the above-mentioned example, the coil 17 for a drive consists of the 1 group's A coils which consisted of the first electric conduction pattern 23 and the second electric conduction pattern 25 which were formed by the photolithography method on the stator substrate 16. And as shown in drawing 9 , after forming the first group's A coil on the stator substrate 16, the second group's B coil is formed on the first group's A coil by repeating the processes 2-12 of drawing 3 . In this case, since it connects mutually and connects with an electrode 18 like the first group A who also shows each coil of the second group B to drawing 8 , the first group A and the second group B will be connected as shown in drawing 10 as a whole.
[0046] Here, as each coil of each phase, i.e., U phase, V phase, and W phase is shown in the equal circuit of drawing 11 , two coils, the first group each other connected to a serial, respectively and the second group, will be further connected to juxtaposition. Thereby, the coil in each phase becomes half resistance as compared with the case where it is shown in drawing 8 . Therefore, according to the coil for a drive equipped with the coil of the first group A and the second group B by which the laminating was carried out, even if it narrows width of face of a pattern and makes [many] the number of turns, coil resistance will be pushed low and big torque will be acquired by that of ********.
[0047] Moreover, when it has the coil of the first group A and the second group B by which the laminating was carried out as mentioned above, the first group A is connected to an electrode 18 like the case of drawing 8 . As it uses as a coil for a drive and the second group B is connected to electrode with an another electrode 18, you may make it detect the induced voltage generated in the second group B with rotation of Rota 14 by using this another electrode as a detection electrode. In this case, rotation location detection and/or rotational-speed detection of Rota 14 are performed by detecting the electrical potential difference generated in the second group B.
[0048] Furthermore, since this second group's B pattern is detailed, rotation location detection and/or rotational-speed detection of Rota 14 are more highly precise, and are performed. And since this second group's B pattern is arranged corresponding to the perimeter of Rota 14, full-time detection is also attained.
[0049] Drawing 12 shows the second example of the small motor by this invention. That is, in drawing 12 , the small motor 40 consists of the flat stator 41, bearing 42 with which the lower part of bearing 41a formed near the core of this stator 41 was equipped, a revolving shaft 43 supported by this bearing 41a and bearing 42 pivotable, and Rota 44 fixed to this revolving shaft 43.
[0050] It is constituted as thrust bearing so that the above-mentioned bearing 41a may support a revolving shaft 43 in the direction of a path and bearing 42 may support a revolving shaft to shaft orientations.
[0051] Above-mentioned Rota 44 has annular Rota magnet 44a with which the inferior surface of tongue was equipped while being arranged so that the whole surface (in the case of illustration top face) of a stator 41 may be countered. In illustration, it is constituted by another object and fixed to the inferior surface of tongue of Rota 44, but this Rota magnet 44a may be directly

formed of the spatter etc. to the inferior surface of tongue of Rota 44. Moreover, Rota 44 may be formed in a revolving shaft 43 and one.
[0052] Here, multi-electrode magnetization of the Rota magnet 44a is carried out so that N pole and the south pole may be located in a line by turns along with a circumferencial direction.
[0053] On the other hand, the stator 41 is equipped with the stator yoke 46 which consists of the magnetic substance prepared on the base 45, and the stator substrate 47 formed on it. As this stator substrate 47 is shown in drawing 3 like the stator substrate 16 mentioned above, the coil 48 for a drive, the electrode (not shown), etc. are formed in that front face by the photolithography method.
[0054] In this case, since the base 45 and the stator substrate 47 of a stator 41 consist of non-magnetic material, they need to use the magnetism of Rota magnet 44a effectively, and need to increase the magnetic flux interlinked in the coil 47 for a drive. For this reason, the stator yoke 46 which consists of the magnetic substance is formed.
[0055] Moreover, you may make it the stator substrate 47 equip the bottom of the first insulating layer 50 with a magnetic layer 49, as shown in drawing 13 instead of forming the above-mentioned stator yoke 46.
[0056] Here, formation processes, such as a magnetic layer to the stator substrate 47 in drawing 12 , the coil 48 for a drive, and an electrode, are explained one by one using drawing 13 . In point ** and a process 1, the magnetic layer 49 which acts on the front face of the stator substrate 47 as a back yoke is formed. Formation of this magnetic layer 49 is performed by PVD etc. in the magnetic substance, such as nickel and a soft ferrite. Next, the first insulating layer 50 is formed in the front face of the stator substrate 47 in a process 2. in this case, formation of an insulating layer 50 — for example, SiO2 Si3 N4 etc. — it is used and is performed by PVD, a CVD method, etc. and resin coating. Moreover, when the oxide of an ingredient is an insulator like Si substrate in the stator substrate 47, an insulating layer 50 may be formed by heating the stator substrate 47 to an elevated temperature in an oxidizing atmosphere.
[0057] Then, in a process 3, the first conductive layer 51 which should serve as a coil for a drive and a connection pattern is formed from on an insulating layer 50. In this case, a conductive layer 51 is formed of PVD, plating, etc. in conductors, such as copper, aluminum, gold, and nickel.

[0058] Next, in a process 4, from on the first conductive layer 51, the photoresist 52 which is a giant-molecule resin ingredient is applied, and at a process 5, the first photo mask 30 shown in drawing 4 is used, and it is exposed.
[0059] And in a process 6, the unexposed excessive photoresist 52 is removed by washing etc. and the part of the first conductive layer 51 exposed by removal of a photoresist 52 is removed by etching in a process 7. Then, at a process 8, the solvent which does not act on the first insulating layer 50 of the above and the first conductive layer 51 is used, and the residual photoresist 52 is removed. The first electric conduction pattern 53 which should constitute the part, connection pattern, and electrode of the coil 48 for a drive which has a predetermined pattern in this way will be formed.
[0060] Then, in a process 9, the second insulating layer 54 is formed in the whole front face of the stator substrate 47 so that this first electric conduction pattern 53 may be covered.
[0061] And in a process 10, the second photo mask 31 shown in drawing 5 is used, and window part 54a for energization is formed to this second insulating layer 54.
[0062] Next, in a process 11, the third photo mask 32 shown in drawing 6 is used, and the second electric conduction pattern 55 is formed from on the second insulating layer 54 by the same procedure as the process 3 thru/or process 8 mentioned above.
[0063] Then, in a process 12, from on the second electric conduction pattern 55, in order to prevent the pattern short-circuit by adhesion of conductive dust, and oxidation of a conductive layer, the third insulating layer 56 for pattern protection is formed so that the whole front face of the stator substrate 47 may be covered.
[0064] Finally in a process 13, the fourth photo mask 33 shown in drawing 7 is used, and window part 56a for electric supply is formed to the third insulating layer 56.
[0065] In this way, connection is carried out as six coils show the coil 48 for a drive of each

other constituted with the first electric conduction pattern 53 and the second electric conduction pattern 55 to drawing 8 , respectively in the plurality by the coil pattern of the first electric conduction pattern 53 which laps up and down, and the second electric conduction pattern 55, and illustration. While the coil for a drive mutually located in the radial opposite side by this is connected to a serial A side besides one coil for a drive will be mutually connected among the coils for a drive of each phase of the three phase connected to the serial, i.e., U phase, V phase, and W phase, and a side besides the coil for a drive of another side will be connected to one of the electrodes 18, respectively, and the coil 47 for a drive of a three phase is constituted.

[0066] According to the small motor 40 of such a configuration, the field generated in this coil 47 for a drive acts to N poles each and the south pole of Rota magnet 44a by energizing from an electrode to each coil 47 for a drive on the stator substrate 47, respectively. Thereby, Rota 44 carries out a rotation drive around a revolving shaft 43.

[0067] Furthermore, when the magnetic layer 49 formed on the stator yoke 46 arranged in the bottom of the stator substrate 47 or the stator substrate 47 acts as a back yoke, the magnetic flux of Rota magnet 44a will be used effectively. In addition, to the case of a magnetic layer 49, since the gap between a back yoke and rotary magnet 44a is more narrow, a flux linkage with the coil of Rota magnet 44a will increase further.

[0068] Like the stator substrate shown in drawing 9 also in this case, after forming the first group's A coil on the stator substrate 47, as shown in drawing 14 , the second group's B coil may be formed on the first group's A coil by repeating the processes 3-13 of drawing 13 .

[0069] Thereby, when two coils, the first group by whom each coil of each phase, i.e., U phase, V phase, and W phase is mutually connected to a serial, respectively, and the second group, are further connected to juxtaposition, the coil in each phase becomes half resistance as compared with the case of only the first group's A coil. Moreover, only the second group's B coil is connected to an electrode other than the electrode to which driver voltage is impressed, and by using this another electrode as a detection electrode, when detecting the induced voltage generated in the second group B with rotation of Rota 44, rotation location detection and/or rotational-speed detection of Rota 44 are performed, for example.

[0070] Drawing 15 shows the third example of the small motor by this invention. That is, in drawing 15 , the small motor 60 consists of the flat stator 61, bearing 62a and 62b which it had near the core of this stator 61, a revolving shaft 63 supported by this bearing 62a and 62b pivotable, and Rota 64 fixed to this revolving shaft 63.

[0071] It is constituted as thrust bearing so that the above-mentioned bearing 62a may support a revolving shaft 63 in the direction of a path and bearing 62b may support a revolving shaft to shaft orientations. The small motor 60 by this example is a different configuration in the small motor 10 which showed only the point of having this bearing 62a to drawing 1 and drawing 2 .

[0072] Above-mentioned Rota 64 has annular Rota magnet 64a with which the inferior surface of tongue was equipped while being arranged so that the whole surface (in the case of illustration top face) of a stator 61 may be countered. In illustration, it is constituted by another object and fixed to the inferior surface of tongue of Rota 64, but this Rota magnet 64a may be directly formed of the spatter etc. to the inferior surface of tongue of Rota 64. Moreover, Rota 64 may be formed in a revolving shaft 63 and one.

[0073] Here, multi-electrode magnetization of the Rota magnet 64a is carried out so that N pole and the south pole may be located in a line by turns along with a circumferencial direction.

[0074] On the other hand, the stator 61 is equipped with the stator substrate 66 laid on the base 65. As this stator substrate 66 is shown in drawing 3 , the coil 67 for a drive, the electrode (not shown), etc. are formed in that front face by the photolithography method. Here, in order that this stator 61 may increase the magnetic flux interlinked in the coil 67 for a drive so that the magnetism of Rota magnet 64a may be used effectively, it will act as York for magnetic-path formation by forming the field which the base 65 is formed from the magnetic substance, or counters the whole stator substrate 66 or Rota magnet 64a preferably from the magnetic substance.

[0075] According to the small motor 60 of such a configuration, the field generated in this coil 67

for a drive acts to N poles each and the south pole of Rota magnet 64a by energizing from an electrode to each coil 67 for a drive on the stator substrate 66, respectively. Thereby, Rota 64 carries out a rotation drive around a revolving shaft 63.

[0076] Here, since the coil 67 for a drive on the stator substrate 66 is formed by the photolithography method, its dimensional accuracy and positioning accuracy of a coil coil are very high, therefore its property degradation of the motor produced by the precision fall at the time of manufacture decreases extremely. Moreover, since the mutual connection of the coil 67 for a drive and the connection to an electrode are formed in the coil 67 for a drive, and coincidence by the photolithography method and adhesion of a up to [the stator substrate 66 of the coil 67 for a drive] and the soldering activity over the electrode of a coil coil terminal are unnecessary, working efficiency will improve and assembly cost will be reduced sharply.

[0077] In this case, since the coil 67 for a drive is constituted by the pattern of the bilayer of the first electric conduction pattern 23 and the second electric conduction pattern 25, as compared with the case of a flexible printed coil, the width of face of a pattern is formed widely conventionally. Therefore, since coil resistance is reduced, it is possible to pass a big drive current. For this reason, sufficient torque will be acquired.

[0078] In addition, in the above-mentioned example, although the coil for a drive consists of coils of one group or two groups by whom the laminating was done, not only this but the coil for a drive may consist of two or more groups' coils by carrying out the laminating of the third and fourth group's coil further. By this, when each group's coil is mutually connected to juxtaposition, the combined-resistance value of a coil will be reduced further.

[0079] Moreover, rotation location detection and/or rotational-speed detection of Rota 64 may be made to be performed by connecting only the coil of one group in two or more groups' coil to another electrode, and detecting the induced voltage generated in the coil of groups involved.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] the first example of the small motor by this invention is shown — it is a fracture top view a part.
[Drawing 2] It is the outline sectional view of the small motor of drawing 1 .
[Drawing 3] It is process drawing showing an example of the production process of the stator substrate in the small motor of drawing 1 one by one.
[Drawing 4] It is the top view showing the mask used with the first conductive layer formation process of drawing 3 .
[Drawing 5] It is the top view showing the mask used with the energization hole formation process of drawing 3 .
[Drawing 6] It is the top view showing the mask used with the second conductive layer formation process of drawing 3 .
[Drawing 7] It is the top view showing the mask used with the electrode formation process for electric supply of drawing 3 .
[Drawing 8] It is the circuit diagram showing an example of the connection of the coil for a drive in the small motor of drawing 1 .
[Drawing 9] It is the sectional view showing other examples of a configuration of the stator substrate in the small motor of drawing 1 .
[Drawing 10] It is the circuit diagram showing an example of the connection of the coil for a drive in the stator substrate of drawing 9 .
[Drawing 11] It is the representative circuit schematic of the coil by the connection of drawing 10 .
[Drawing 12] It is the outline sectional view showing the second example of the small motor by this invention.
[Drawing 13] It is process drawing showing other examples of the production process of the stator substrate in the small motor of drawing 1 one by one.
[Drawing 14] It is the sectional view showing the example of further others of the production process of the stator substrate in the small motor of drawing 1 .
[Drawing 15] It is the outline sectional view showing the third example of the small motor by this invention.
[Drawing 16] It is the outline sectional view showing an example of the conventional small motor.

[Brief Description of Notations]
10 Small Motor
11 Stator
11a Bearing
12 Bearing
13 Revolving Shaft
14 Rota
14a Rota magnet
15 Base

16 Stator Substrate
17 Coil for Drive
18 Electrode
20 Insulating Layer
21 First Conductive Layer
22 Photoresist
23 First Electric Conduction Pattern
24 Second Insulating Layer
25 Second Electric Conduction Pattern
26 Third Insulating Layer
30, 31, 32, 33 Photo mask
40 Small Motor
41 Stator
41a Bearing
42 Bearing
43 Revolving Shaft
44 Rota
44a Rota magnet
45 Base
46 Stator Yoke
47 Stator Substrate
48 Coil for Drive
49 Magnetic Layer
50 Insulating Layer
51 First Conductive Layer
52 Photoresist
53 First Electric Conduction Pattern
54 Second Insulating Layer
55 Second Electric Conduction Pattern
56 Third Insulating Layer
60 Small Motor
61 Stator
62a, 62b Bearing
63 Revolving Shaft
64 Rota
64a Rota magnet
65 Base
66 Stator Substrate
67 Coil for Drive

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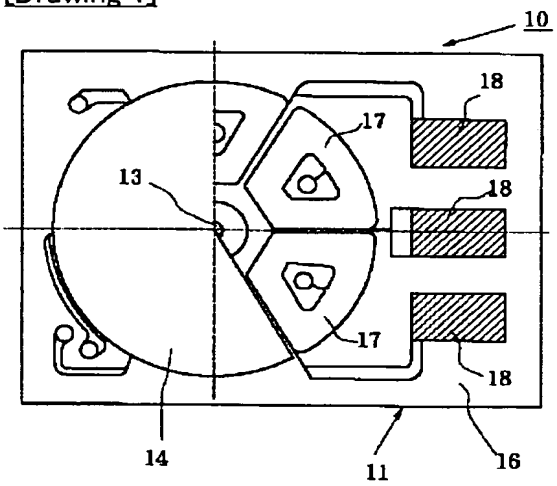
DRAWINGS

[Drawing 1]



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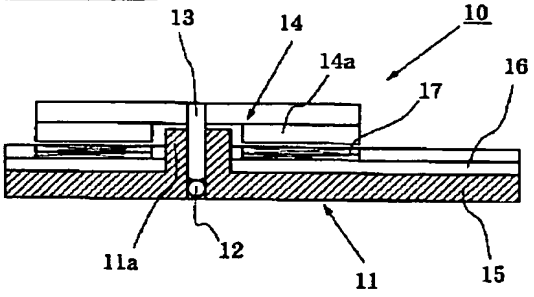

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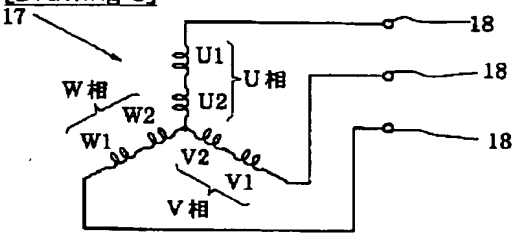

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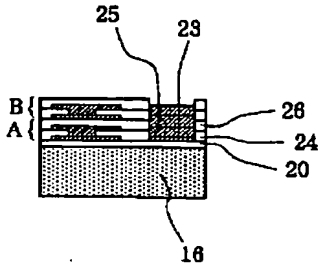

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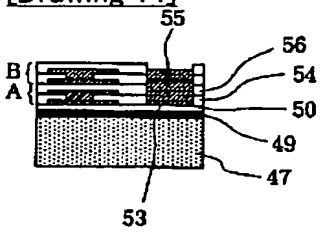

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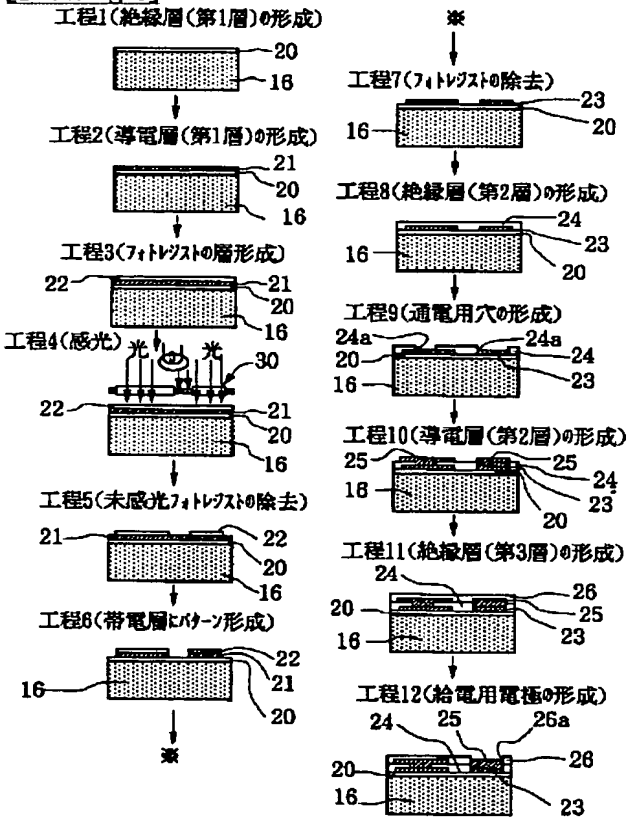

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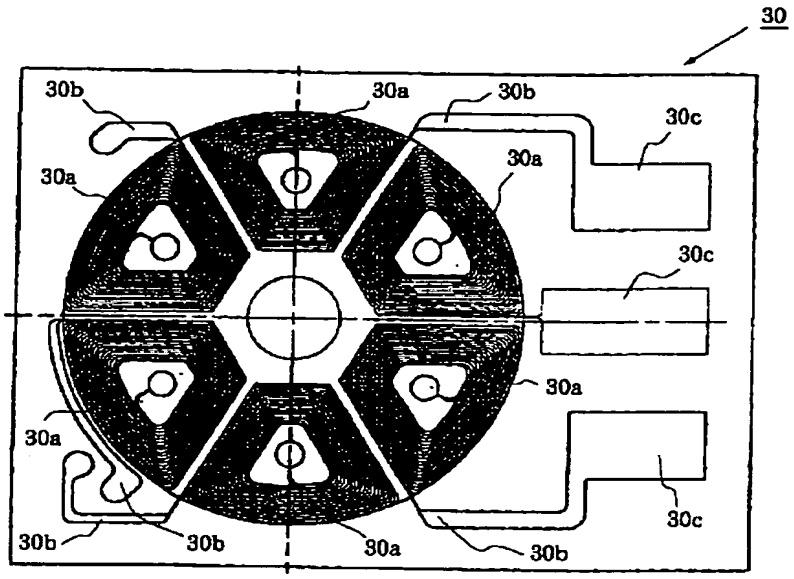

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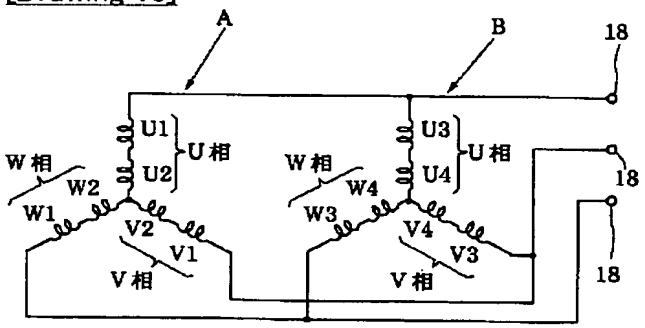

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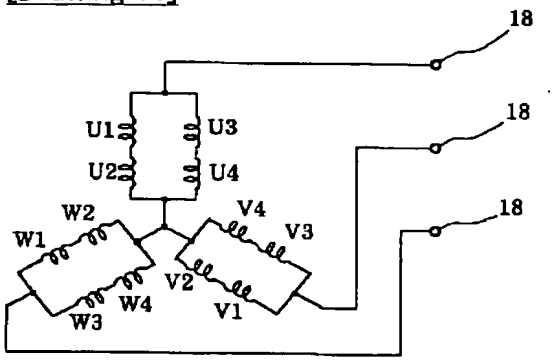

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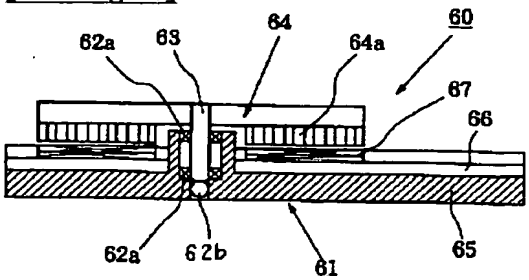

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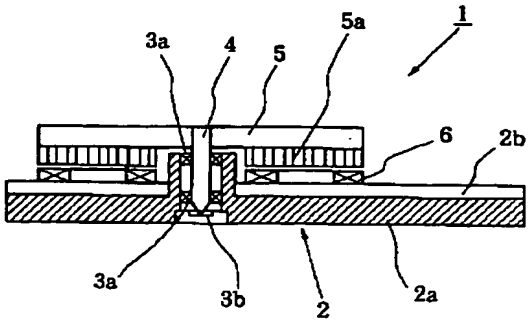
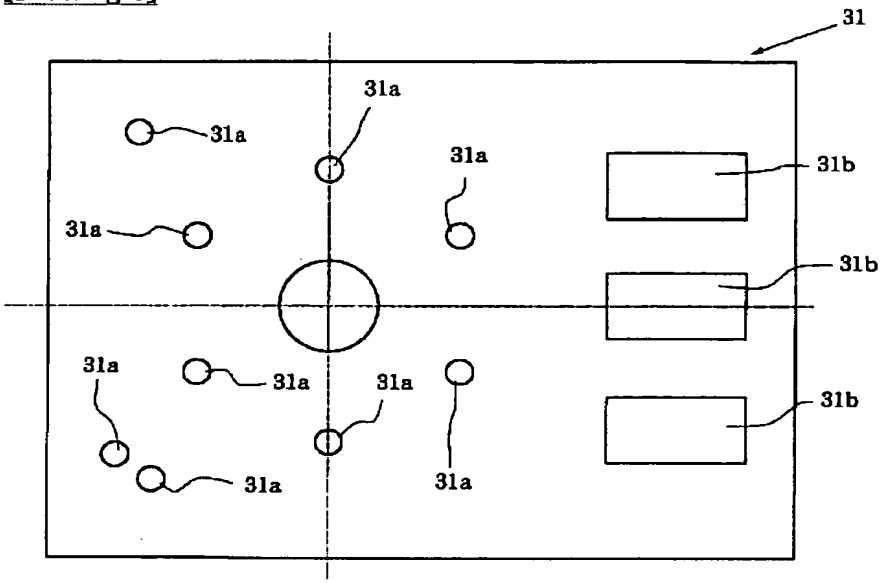


[Drawing 5]



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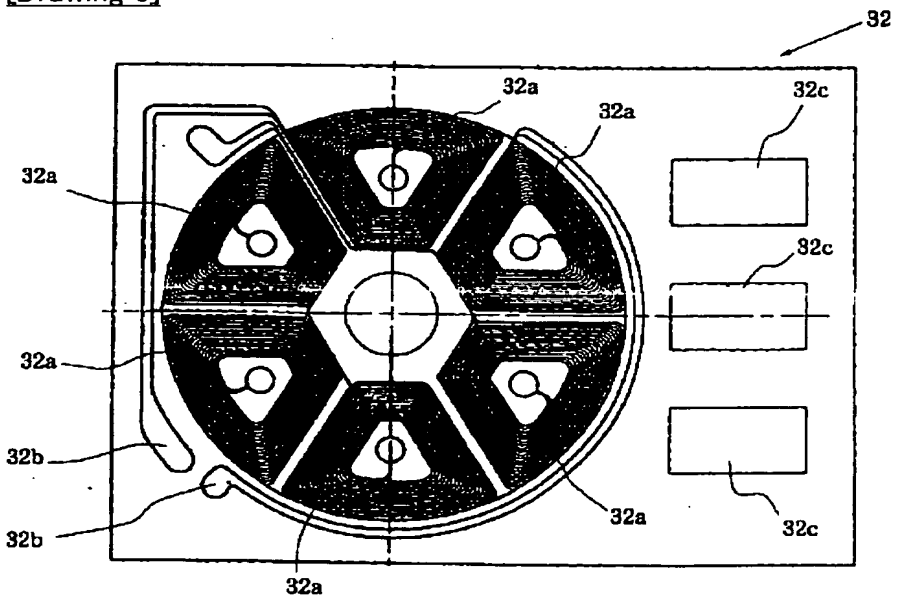

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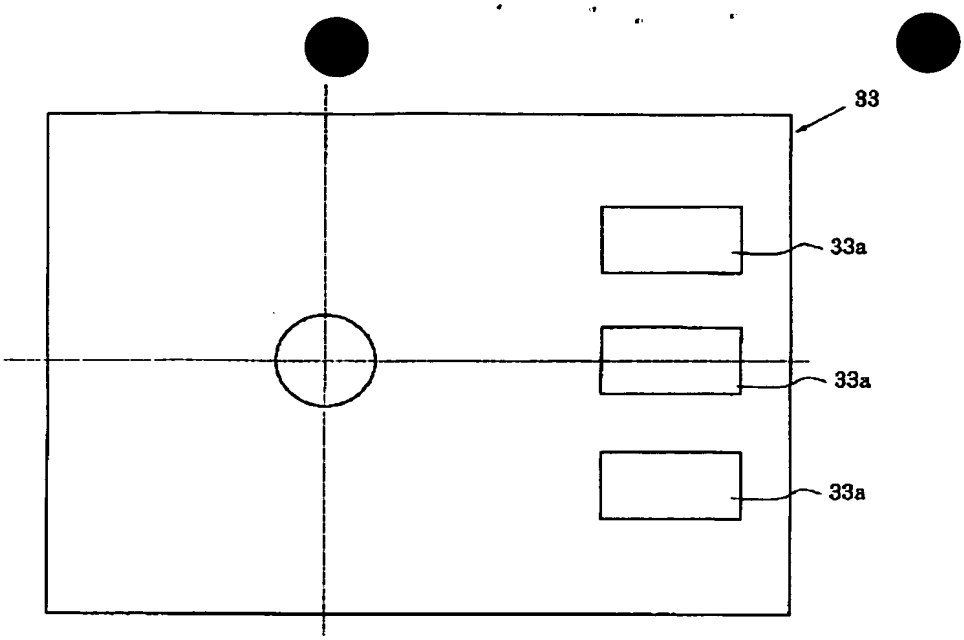

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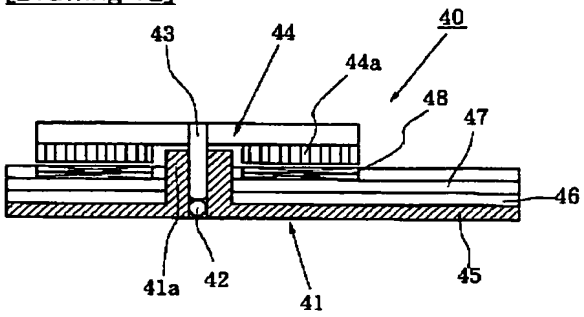

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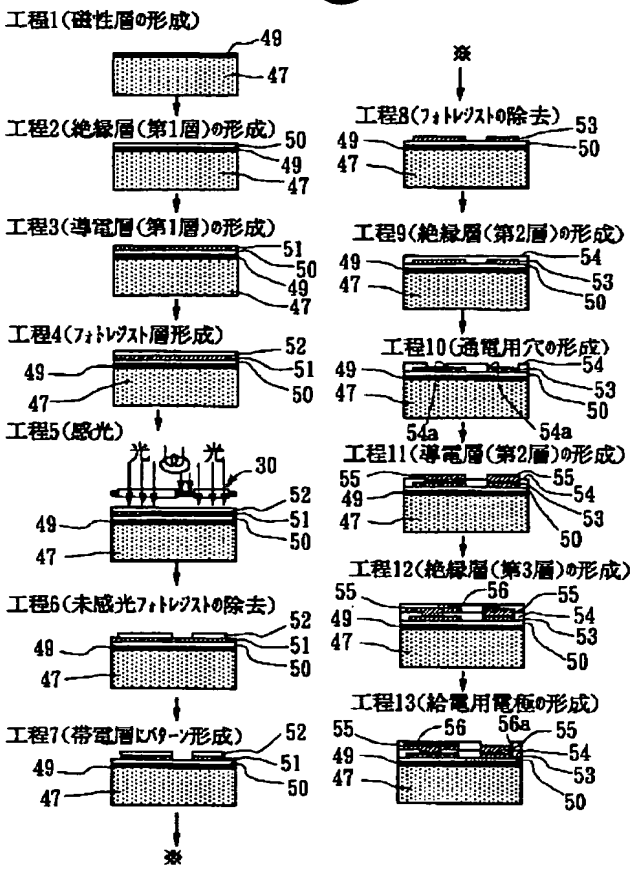

[Translation done.]

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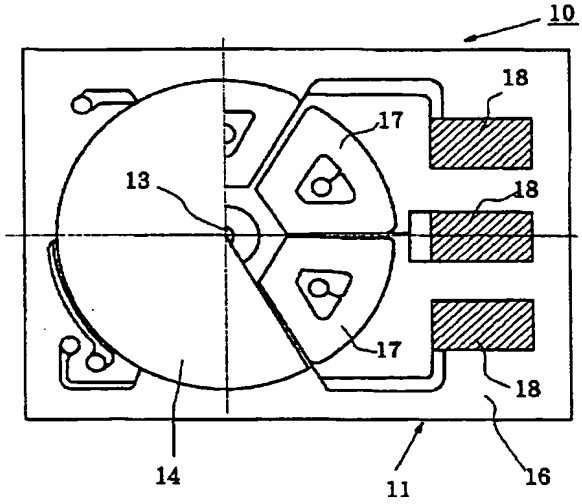
(54)【発明の名称】　小型モータ

(57)【要約】

【目的】　本発明は、駆動用コイルが小型且つ高精度に形成されると共に、十分なモータトルクが得られるようにした、小型モータを提供すること。

【構成】　固定配置され、かつ少なくとも一方の面に駆動用コイル１７が設けられているステータ基板１６と、このステータ基板に対向して回転可能に支持され、かつ多極に着磁されているマグネットを備えた円板状のロータ１４と、を有する、小型モータ１０において、上記駆動用コイルが、上記ステータ基板の一面にフォトリソグラフィ法により形成された複数層のパターン２３，２５により形成されるように小型モータ１０を構成する。



1

【特許請求の範囲】

【請求項１】　固定配置され、かつ少なくとも一方の面に駆動用コイルが設けられているステータ基板と、このステータ基板に対向して回転可能に支持され、かつ多極に着磁されているマグネットを備えた円板状のロータと、を有する、小型モータにおいて、

上記駆動用コイルが、上記ステータ基板の一面にフォトリソグラフィ法により形成された複数層のパターンにより形成されていることを特徴とする、小型モータ。

【請求項２】　上記複数層のパターンが、一つのグループとして互いに結線されていることを特徴とする、請求項１に記載の小型モータ。

【請求項３】　上記複数層のパターンが、複数のグループに分割され、各グループのパターンが、互いに結線されていることを特徴とする、請求項１に記載の小型モータ。

【請求項４】　上記複数のグループのパターンのうち、一つのグループのパターンが、位置検出及び／または速度検出のために利用されることを特徴とする、請求項３に記載の小型モータ。

【請求項５】　上記ステータ基板上に、磁路構成用のヨーク層が形成されていることを特徴とする、請求項１から４の何れかに記載の小型モータ。

【請求項６】　上記ステータ基板上に形成されたパターンが、磁性体から構成されていることを特徴とする、請求項１から５の何れかに記載の小型モータ。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、ステータ基板と、円板状のロータと、このステータ基板に配設された駆動用コイルと、を有する、小型モータに関するものである。

【０００２】

【従来の技術】従来、このような小型モータは、例えば図１６に示すように、構成されている。すなわち、図１６において、小型モータ１は、平坦なステータ２と、このステータ２の中心付近に設けられた軸受３ａ，３ｂと、この軸受３ａ，３ｂにより回転可能に支持された回転軸４と、この回転軸４に固定されたロータ５とから構成されている。

【０００３】この軸受３ａは、回転軸４を径方向に支持するように、含油メタルや潤滑性樹脂等から構成されており、また軸受３ｂは、回転軸を軸方向に支持するように、スラスト軸受として構成されている。

【０００４】上記ロータ５は、ステータ２の一面（図示の場合、上面）に対向するように配設されていると共に、その下面に取り付けられた環状のロータマグネット５ａを有している。

【０００５】ここで、ロータマグネット５ａは、円周方向に沿ってＮ極，Ｓ極が交互に並ぶように、多極着磁されている。

2

【０００６】これに対して、ステータ２は、ベース２ａ上に載置されたステータ基板２ｂを備えている。このステータ基板２ｂは、固定ヨークとして作用するように、例えば鉄板，電磁鋼板等により形成されていると共に、このロータマグネット５ａの各磁極に対向するように、円周方向に沿って等角度間隔に配設された複数個の駆動用コイル６と、図示しないホール素子，抵抗，コンデンサ等の回路素子を有している。

【０００７】このように構成された小型モータ１によれば、ステータ基板２ｂ上の各駆動用コイル６に対してそれぞれ通電することにより、この駆動用コイル６に発生する磁界が、ロータマグネット５ａの各Ｎ極及びＳ極に対して作用する。これにより、ロータ５が、回転軸４の周りで回転駆動する。

【０００８】

【発明が解決しようとする課題】ところで、近年あらゆる商品分野において、ダウンサイジング，コンパクト化が進められており、各種機器の駆動源として使用される小型モータについても、益々小型化，薄型化の要請が強くなってきている。

【０００９】従って、上述のような小型モータ１においては、小型化するにあたって、特に駆動用コイル６の薄型化が必要になる。このため、薄型の駆動用コイルを作製するために、例えば樹脂ベースにコイルを一体成形したフレキシブルプリントコイルなる製品を使用することが考えられる。

【００１０】しかしながら、このフレキシブルプリントコイルは、より薄型化した場合には、樹脂ベースの両面に導電パターンにより駆動用コイルを形成する必要があるが、両面に駆動用コイルを形成する場合には、製造途中で、樹脂ベースを反転させることが必要となる。したがって、樹脂ベースの両面への駆動用コイルの位置決めが困難になるという問題がある。

【００１１】これに対して、樹脂ベースの一面のみに駆動用コイルを形成する場合には、導電パターンの幅の点から、駆動用コイルのターン数が少なくなって、モータトルクが低下してしまう。また、導電パターンを微細化すると、導電パターンの電気抵抗が増大してしまい、駆動用コイルを流れる電流が少なくなって、モータトルクが低下してしまうという問題があった。

【００１２】本発明は、以上の点に鑑み、駆動用コイルが小型且つ高精度に形成されると共に、十分なモータトルクが得られるようにした、小型モータを提供することを目的としている。

【００１３】

【課題を解決するための手段】上記目的は、本発明によれば、固定配置され、かつ少なくとも一方の面に駆動用コイルが設けられているステータ基板と、このステータ基板に対向して回転可能に支持され、かつ多極に着磁されているマグネットを備えた円板状のロータと、を有す

る、小型モータにおいて、上記駆動用コイルが、上記ステータ基板の一面にフォトリソグラフィ法により形成された複数層のパターンにより形成されていることを特徴とする、小型モータにより、達成される。

【００１４】本発明による小型モータは、好ましくは、上記複数層のパターンが、一つのグループとして互いに結線されている。

【００１５】本発明による小型モータは、好ましくは、上記複数層のパターンが、複数のグループに分割され、各グループのパターンが、互いに結線されている。

【００１６】本発明による小型モータは、好ましくは、上記複数のグループのパターンのうち、一つのグループのパターンが、位置検出及び／または速度検出のために利用される。

【００１７】本発明による小型モータは、好ましくは、上記ステータ基板上に、磁路構成用のヨーク層が形成されている。

【００１８】本発明による小型モータは、好ましくは、上記ステータ基板上に形成されたパターンが、磁性体から構成されている。

【００１９】

【作用】上記構成によれば、駆動用コイルが、ステータ基板の一面に、フォトリソグラフィ法により形成された複数層のパターンから形成されているので、フレキシブルプリントコイルに比較して、非常に薄型化されると共に、駆動用コイルを構成するパターンに関して、非常に高い寸法精度及び位置決め精度が得られることになる。

【００２０】上記複数層のパターンが、一つのグループとして互いに結線されている場合には、駆動用コイルのターン数が同じ場合、個々のパターンの幅を広くすることが可能であり、コイル抵抗値が低減される。従って、より多くの駆動電流を駆動用コイルに流すことができる。

【００２１】上記複数層のパターンが、複数のグループに分割され、各グループのパターンが、互いに結線されている場合には、抵抗値が大幅に低減できる複数組の駆動用コイルを構成することが可能となる。

【００２２】上記複数のグループのパターンのうち、一つのグループのパターンが、位置検出及び／または速度検出のために利用される場合には、ロータの回転に伴いこのグループのパターンに誘起電圧が発生するため、この誘起電圧を検出して、適宜に処理し、ロータの位置検出及び／または回転速度検出を行う。

【００２３】上記ステータ基板上に、磁路構成用のヨーク層が形成されている場合には、ロータマグネットの磁束が、このヨーク層を通過することになり、駆動用コイルとの鎖交磁束が増大する。したがって、ロータマグネットの磁束がより一層有効活用されることになる。

【００２４】上記ステータ基板上に形成されたパターンが、磁性体から構成されている場合には、駆動用コイル

が磁性体であることから、ロータマグネットの磁束をこのパターンに集めることができるので、発生トルクが増大する。

【００２５】

【実施例】以下、この発明の好適な実施例を図１乃至図１５を参照しながら、詳細に説明する。尚、以下に述べる実施例は、本発明の好適な具体例であるから、技術的に好ましい種々の限定が付されているが、本発明の範囲は、以下の説明において特に本発明を限定する旨の記載がない限り、これらの態様に限られるものではない。

【００２６】図１及び図２は、本発明による小型モータの第一の実施例を示している。すなわち、図１及び図２において、小型モータ１０は、平坦なステータ１１と、このステータ１１の中心付近に形成された軸受部１１ａの下部に備えられた軸受１２と、この軸受部１１ａ及び軸受１２により回転可能に支持された回転軸１３と、この回転軸１３に固定されたロータ１４とから構成されている。

【００２７】上記軸受部１１ａは、回転軸１３を径方向に支持するようになっており、また軸受１２は、回転軸を軸方向に支持するように、スラスト軸受として構成されている。

【００２８】上記ロータ１４は、ステータ１１の一面（図示の場合、上面）に対向するように配設されていると共に、その下面に備えられた環状のロータマグネット１４ａを有している。このロータマグネット１４ａは、図示の場合、別体に構成され、ロータ１４の下面に固定されているが、ロータ１４の下面に対して直接に、例えばスパッタ法等により形成されていてもよい。また、ロータ１４は、回転軸１３と一体に形成されていてもよい。

【００２９】ここで、ロータマグネット１４ａは、円周方向に沿ってＮ極，Ｓ極が交互に並ぶように、多極着磁されている。

【００３０】これに対して、ステータ１１は、ベース１５上に載置されたステータ基板１６を備えている。このステータ基板１６は、例えば図３に示すように、フォトリソグラフィ法によって、その表面に駆動用コイル１７及び電極１８等が形成されている。ここで、このステータ１１は、ロータマグネット１４ａの磁力を有効利用するように、駆動用コイル１７に鎖交する磁束を増大させるため、好ましくは、ベース１５が磁性体から形成され、またはステータ基板１６の全体またはロータマグネット１４ａに対向する領域が、磁性体から形成されていることにより、磁路形成用ヨークとして作用することになる。

【００３１】図３において、ステータ基板１６への駆動用コイル１７及び電極１８等の形成工程を順次に説明する。先づ、工程１においては、ステータ基板１６の表面に第一の絶縁層２０が形成される。この場合、絶縁層２

5

0の形成は、例えばSiO_2やSi_3N_4等を使用して、PVD（Pysical Vapor Deposition）法，CVD（Chemical Vapor Deposition）法等により、あるいは樹脂コーティングにより、行なわれる。また、ステータ基板１６がＳｉ基板のように材料の酸化物が絶縁体である場合には、ステータ基板１６を酸化性雰囲気中にて、高温に熱することにより、絶縁層２０が形成される。

【００３２】続いて、工程２においては、絶縁層２０の上に、駆動用コイルや結線パターンとなるべき第一の導電層２１が形成される。この場合、導電層２１は、例えば銅，アルミニウム，金，ニッケル等の導電体を、ＰＶＤ法やメッキ等により、形成する。

【００３３】次に、工程３において、第一の導電層２１の上から、高分子樹脂材料であるフォトレジスト２２が塗布され、工程４にて、図４に示す第一のフォトマスク３０を使用して、露光される。この場合、第一のフォトマスク３０は、図示のように、駆動用コイル１７の一部，結線パターン及び電極１８の部分に、それぞれ窓部３０ａ，３０ｂ，３０ｃを有するように、構成されている。

【００３４】そして、工程５において、未露光の余分なフォトレジスト２２が洗浄等により除去され、工程６において、フォトレジスト２２の除去により露出した第一の導電層２１の部分が、エッチングによって除去される。その後、工程７にて、上記第一の絶縁層２０及び第一の導電層２１に作用しない溶剤等を使用して、残留フォトレジスト２２が除去される。かくして、所定のパターンを有する駆動用コイル１７の一部，結線パターン及び電極１８を構成すべき第一の導電パターン２３が形成される。

【００３５】続いて、工程８において、この第一の導電パターン２３を覆うように、ステータ基板１６の表面全体に、第二の絶縁層２４が形成される。

【００３６】そして、工程９において、図５に示す第二のフォトマスク３１を使用して、この第二の絶縁層２４に対して、通電用窓部２４ａが形成される。この場合、第二のフォトマスク３１は、図５に示すように、第一の導電パターン２３の各駆動用コイルの接続端子部及び電極１８の部分に、それぞれ窓部３１ａ，３１ｂを有するように、構成されている。

【００３７】次に、工程１０において、図６に示す第三のフォトマスク３２を使用して、上述した工程２乃至工程７と同様の手順によって、第二の絶縁層２４の上から、第二の導電パターン２５が形成される。この場合、第三のフォトマスク３２は、図示のように、駆動用コイル１７の一部，結線パターン及び電極１８の部分に、それぞれ窓部３２ａ，３２ｂ，３２ｃを有するように、構成されている。

【００３８】続いて、工程１１において、第二の導電パ

6

ターン２５の上から、導電性ゴミの付着によるパターンショートや導電層の酸化を防止するため、ステータ基板１６の表面全体を覆うように、パターン保護用の第三の絶縁層２６が形成される。

【００３９】最後に、工程１２において、図７に示す第四のフォトマスク３３を使用して、第三の絶縁層２６に対して、給電用窓部２６ａが形成される。この場合、第四のフォトマスク３３は、第一及び第二の導電パターン２３，２５の電極１８の部分に窓部３３ａを有するように、構成されている。

【００４０】かくして、第一の導電パターン２３及び第二の導電パターン２５により構成される駆動用コイル１７は、上下に重なる第一の導電パターン２３及び第二の導電パターン２５のコイルパターンによる複数個、図示の場合６個のコイルが、それぞれ互いに図８に示すように、結線されている。これにより、互いに半径方向反対側に位置する駆動用コイルが直列に接続されると共に、直列に接続された三相、すなわちＵ相，Ｖ相及びＷ相の各相の駆動用コイルのうち、一方の駆動用コイルの他側が互いに接続され、また他方の駆動用コイルの他側が、それぞれ電極１８の一つに接続されることになり、三相の駆動用コイル１７が構成されている。

【００４１】本実施例による小型モータ１０は、以上のように構成されており、図１及び図２で示すように、ステータ基板１６上の各駆動用コイル１７に対して電極１８からそれぞれ通電することにより、この駆動用コイル１７に発生する磁界が、ロータマグネット１４ａの各Ｎ極及びＳ極に対して作用する。これにより、ロータ１４が、回転軸１３の周りで回転駆動する。

【００４２】本実施例によれば、駆動用コイル１７が、ステータ基板１６の一面に、順次にフォトリソグラフィ法により形成された複数層のパターン２３，２５から形成されているので、フレキシブルプリントコイルに比較して、非常に薄型化されると共に、駆動用コイル１７を構成するパターンに関して、非常に高い寸法精度及び位置決め精度が得られることになる。したがって、製造時の精度低下によって生じるモータの特性劣化が極めて少なくなる。また、このパターン２３，２５は、例えば銅，アルミニウム，金，ニッケル等の導電体層により形成されるので、微細に且つ低抵抗で構成されることになる。

【００４３】従って、例えば駆動用コイル１７のターン数が同じ場合、従来のステータ基板上に導電パターンにより平面的に駆動用コイルを形成したものと比較して、本実施例によれば、複数層のパターン２３，２５により駆動用コイル１７が形成されるため、個々のパターン２３，２５の幅を広くすることが可能であり、コイル抵抗値が低減される。従って、より多くの駆動電流を駆動用コイルに流すことができるので、発生トルクが増大することになる。

7

【００４４】また、コイル抵抗値を同じにした場合には、コイルターン数をより多くすることができるので、同様に発生トルクが増大することになる。さらに、駆動用コイル１７は、従来のように、接着したり、電気的接続のためにハンダ付けする必要がない。また、大きなステータのベース上に、半導体素子の製造の場合と同様に一度に大量の駆動用コイルのパターンを形成し、後から個々のステータ基板に切断することによって、量産も可能となる。したがって、作業効率が高められ、コストも低減されることになる。

【００４５】ところで、上記実施例においては、駆動用コイル１７は、ステータ基板１６上にフォトリソグラフィ法により形成された第一の導電パターン２３及び第二の導電パターン２５から構成された一グループＡのコイルから構成されている。そして、図９に示すように、ステータ基板１６上に、第一のグループＡのコイルを形成した後、図３の工程２から１２を繰り返すことにより、第一のグループＡのコイルの上に、第二のグループＢのコイルが形成される。この場合、第二のグループＢの各コイルも、図８に示す第一のグループＡと同様に、互いに接続され、且つ電極１８に接続されるので、第一のグループＡ及び第二のグループＢは、全体として図１０に示すように接続されることになる。

【００４６】ここで、各相すなわちＵ相，Ｖ相及びＷ相の各コイルは、図１１の等価回路に示すように、それぞれ互いに直列に接続される第一のグループ及び第二のグループの二つのコイルが、さらに並列に接続されることになる。これにより、各相におけるコイルは、図８に示す場合に比較して、半分の抵抗値になる。したがって、積層された第一のグループＡ及び第二のグループＢのコイルを備える駆動用コイルによれば、パターンの幅を狭くして、ターン数を多くしても、コイル抵抗値が低く押さられ得るので、大きなトルクが得られることになる。

【００４７】また、上記のように積層された第一のグループＡ及び第二のグループＢのコイルを備えている場合、第一のグループＡのみを、図８の場合と同様に、電極１８に対して結線して、駆動用コイルとして利用し、第二のグループＢを電極１８とは別の電極に接続するようにして、この別の電極を検出電極として、ロータ１４の回転に伴って第二のグループＢに発生する誘起電圧を検出するようにしてもよい。この場合、第二のグループＢに発生する電圧を検出することにより、ロータ１４の回転位置検出及び／または回転速度検出が行なわれる。

【００４８】さらに、この第二グループＢのパターンが微細であることから、ロータ１４の回転位置検出及び／または回転速度検出がより高精度で行われる。しかも、この第二グループＢのパターンはロータ１４の全周に対応して配設されているため、フルタイムの検出も可能になる。

8

【００４９】図１２は、本発明による小型モータの第二の実施例を示している。すなわち、図１２において、小型モータ４０は、平坦なステータ４１と、このステータ４１の中心付近に形成された軸受部４１ａの下部に備えられた軸受４２と、この軸受部４１ａ及び軸受４２により回転可能に支持された回転軸４３と、この回転軸４３に固定されたロータ４４とから構成されている。

【００５０】上記軸受部４１ａは、回転軸４３を径方向に支持するようになっており、また軸受４２は、回転軸を軸方向に支持するように、スラスト軸受として構成されている。

【００５１】上記ロータ４４は、ステータ４１の一面（図示の場合、上面）に対向するように配設されていると共に、その下面に備えられた環状のロータマグネット４４ａを有している。このロータマグネット４４ａは、図示の場合、別体に構成され、ロータ４４の下面に固定されているが、ロータ４４の下面に対して直接に、例えばスパッタ法等により形成されていてもよい。また、ロータ４４は、回転軸４３と一体に形成されていてもよい。

【００５２】ここで、ロータマグネット４４ａは、円周方向に沿ってＮ極，Ｓ極が交互に並ぶように、多極着磁されている。

【００５３】これに対して、ステータ４１は、ベース４５上に設けられた磁性体から成るステータヨーク４６と、その上に設けられたステータ基板４７を備えている。このステータ基板４７は、前述したステータ基板１６と同様にして、例えば図３に示すように、フォトリソグラフィ法によって、その表面に駆動用コイル４８及び電極（図示せず）等が形成されている。

【００５４】この場合、ステータ４１のベース４５及びステータ基板４７は、非磁性体から構成されているため、ロータマグネット４４ａの磁力を有効利用し、駆動用コイル４７に鎖交する磁束を増大させる必要がある。このため、磁性体から成るステータヨーク４６が設けられている。

【００５５】また、上記ステータヨーク４６を設ける代わりに、ステータ基板４７が、図１３に示すように、第一の絶縁層５０の下に磁性層４９を備えるようにしてもよい。

【００５６】ここで、図１２における、ステータ基板４７への磁性層，駆動用コイル４８及び電極等の形成工程を図１３を用い順次に説明する。先づ、工程１においては、ステータ基板４７の表面に、バックヨークとして作用する磁性層４９が形成される。この磁性層４９の形成は、例えばニッケル，ソフトフェライト等の磁性体をＰＶＤ法等により、行なわれる。次に、工程２においては、ステータ基板４７の表面に第一の絶縁層５０が形成される。この場合、絶縁層５０の形成は、例えばSiO_2やSi₃N₄等を使用して、ＰＶＤ法，ＣＶＤ法等に

より、あるいは樹脂コーティングにより、行なわれる。また、ステータ基板４７がＳｉ基板のように材料の酸化物が絶縁体である場合には、ステータ基板４７を酸化性雰囲気中にて、高温に熱することにより、絶縁層５０が形成され得る。

【００５７】続いて、工程３においては、絶縁層５０の上から、駆動用コイルや結線パターンとなるべき第一の導電層５１が形成される。この場合、導電層５１は、例えば銅，アルミニウム，金，ニッケル等の導電体を、ＰＶＤ法やメッキ等により、形成される。

【００５８】次に、工程４において、第一の導電層５１の上から、高分子樹脂材料であるフォトレジスト５２が塗布され、工程５にて、図４に示す第一のフォトマスク３０を使用して、露光される。

【００５９】そして、工程６において、未露光の余分なフォトレジスト５２が洗浄等により除去され、工程７において、フォトレジスト５２の除去により露出した第一の導電層５１の部分が、エッチングによって除去される。その後、工程８にて、上記第一の絶縁層５０及び第一の導電層５１に作用しない溶剤等を使用して、残留フォトレジスト５２が除去される。かくして、所定のパターンを有する駆動用コイル４８の一部，結線パターン及び電極を構成すべき第一の導電パターン５３が形成されることになる。

【００６０】続いて、工程９において、この第一の導電パターン５３を覆うように、ステータ基板４７の表面全体に、第二の絶縁層５４が形成される。

【００６１】そして、工程１０において、図５に示す第二のフォトマスク３１を使用して、この第二の絶縁層５４に対して、通電用窓部５４ａが形成される。

【００６２】次に、工程１１において、図６に示す第三のフォトマスク３２を使用して、上述した工程３乃至工程８と同様の手順によって、第二の絶縁層５４の上から、第二の導電パターン５５が形成される。

【００６３】続いて、工程１２において、第二の導電パターン５５の上から、導電性ゴミの付着によるパターンショートや導電層の酸化を防止するため、ステータ基板４７の表面全体を覆うように、パターン保護用の第三の絶縁層５６が形成される。

【００６４】最後に、工程１３において、図７に示す第四のフォトマスク３３を使用して、第三の絶縁層５６に対して、給電用窓部５６ａが形成される。

【００６５】かくして、第一の導電パターン５３及び第二の導電パターン５５により構成される駆動用コイル４８は、上下に重なる第一の導電パターン５３及び第二の導電パターン５５のコイルパターンによる複数個、図示の場合６個のコイルが、それぞれ互いに図８に示すように、結線されている。これにより、互いに半径方向反対側に位置する駆動用コイルが直列に接続されると共に、直列に接続された三相、すなわちＵ相，Ｖ相及びＷ相の

各相の駆動用コイルのうち、一方の駆動用コイルの他側が互いに接続され、また他方の駆動用コイルの他側が、それぞれ電極１８の一つに接続されることになり、三相の駆動用コイル４７が構成されている。

【００６６】このような構成の小型モータ４０によれば、ステータ基板４７上の各駆動用コイル４７に対して電極からそれぞれ通電することにより、この駆動用コイル４７に発生する磁界が、ロータマグネット４４ａの各Ｎ極及びＳ極に対して作用する。これにより、ロータ４４が、回転軸４３の周りで回転駆動する。

【００６７】さらに、ステータ基板４７の下に配設されたステータヨーク４６またはステータ基板４７上に形成された磁性層４９が、バックヨークとして作用することにより、ロータマグネット４４ａの磁束が、有効利用されることになる。なお、磁性層４９の場合には、バックヨークとロータリマグネット４４ａとの間のギャップがより狭いので、ロータマグネット４４ａのコイルとの鎖交磁束がより一層増大されることになる。

【００６８】この場合も、図９に示したステータ基板と同様にして、ステータ基板４７上に、第一のグループＡのコイルを形成した後、図１３の工程３から１３を繰り返すことにより、図１４に示すように、第一のグループＡのコイルの上に、第二のグループＢのコイルが形成されてもよい。

【００６９】これにより、各相すなわちＵ相，Ｖ相及びＷ相の各コイルは、それぞれ互いに直列に接続される第一のグループ及び第二のグループの二つのコイルが、さらに並列に接続される場合には、各相におけるコイルは、第一のグループＡのコイルのみの場合に比較して、半分の抵抗値になる。また、例えば第二のグループＢのコイルのみが、駆動電圧が印加される電極とは別の電極に接続され、この別の電極を検出電極として、ロータ４４の回転に伴って第二のグループＢに発生する誘起電圧を検出する場合には、ロータ４４の回転位置検出及び／または回転速度検出が行なわれる。

【００７０】図１５は、本発明による小型モータの第三の実施例を示している。すなわち、図１５において、小型モータ６０は、平坦なステータ６１と、このステータ６１の中心付近に備えられた軸受６２ａ，６２ｂと、この軸受６２ａ，６２ｂにより回転可能に支持された回転軸６３と、この回転軸６３に固定されたロータ６４とから構成されている。

【００７１】上記軸受６２ａは、回転軸６３を径方向に支持するようになっており、また軸受６２ｂは、回転軸を軸方向に支持するように、スラスト軸受として構成されている。本実施例による小型モータ６０は、この軸受６２ａが備えられている点のみ、図１及び図２に示した小型モータ１０とは異なる構成である。

【００７２】上記ロータ６４は、ステータ６１の一面（図示の場合、上面）に対向するように配設されている

11

と共に、その下面に備えられた環状のロータマグネット６４ａを有している。このロータマグネット６４ａは、図示の場合、別体に構成され、ロータ６４の下面に固定されているが、ロータ６４の下面に対して直接に、例えばスパッタ法等により形成されていてもよい。また、ロータ６４は、回転軸６３と一体に形成されていてもよい。

【００７３】ここで、ロータマグネット６４ａは、円周方向に沿ってＮ極，Ｓ極が交互に並ぶように、多極着磁されている。

【００７４】これに対して、ステータ６１は、ベース６５上に載置されたステータ基板６６を備えている。このステータ基板６６は、例えば図３に示すように、フォトリソグラフィ法によって、その表面に駆動用コイル６７及び電極（図示せず）等が形成されている。ここで、このステータ６１は、ロータマグネット６４ａの磁力を有効利用するように、駆動用コイル６７に鎖交する磁束を増大させるため、好ましくは、ベース６５が磁性体から形成され、またはステータ基板６６の全体またはロータマグネット６４ａに対向する領域が、磁性体から形成されていることにより、磁路形成用ヨークとして作用することになる。

【００７５】このような構成の小型モータ６０によれば、ステータ基板６６上の各駆動用コイル６７に対して電極からそれぞれ通電することにより、この駆動用コイル６７に発生する磁界が、ロータマグネット６４ａの各Ｎ極及びＳ極に対して作用する。これにより、ロータ６４が、回転軸６３の周りで回転駆動する。

【００７６】ここで、ステータ基板６６上の駆動用コイル６７は、フォトリソグラフィ法によって、形成されているので、コイル巻線の寸法精度及び位置決め精度が極めて高く、したがって、製造時の精度低下によって生じるモータの特性劣化が極めて少なくなる。また、駆動用コイル６７の相互の結線及び電極に対する結線が、フォトリソグラフィ法により、駆動用コイル６７と同時に形成されるので、駆動用コイル６７のステータ基板６６上への接着作業や、コイル巻線端末の電極に対するハンダ付け作業が不要であることから、作業効率が向上し、組立コストが大幅に低減されることになる。

【００７７】この場合、駆動用コイル６７は、第一の導電パターン２３及び第二の導電パターン２５の二層のパターンによって構成されているので、従来フレキシブルプリントコイルの場合に比較して、パターンの幅が広く形成される。したがって、コイル抵抗値が低減されるので、大きな駆動電流を流すことが可能である。このため、十分なトルクが得られることになる。

【００７８】尚、上記実施例においては、駆動用コイルは、一グループまたは積層された二グループのコイルから構成されているが、これに限らず、駆動用コイルは、さらに、第三，第四のグループのコイルを積層することにより、複数グループのコイルから構成されていてもよい。これにより、各グループのコイルを互いに並列に接続した場合には、コイルの合成抵抗値はさらに低減されることになる。

12

【００７９】また、複数グループのコイルのうちの一グループのコイルのみを、別の電極に接続して、当該グループのコイルに発生する誘起電圧を検出することにより、ロータ６４の回転位置検出及び／または回転速度検出が行なわれるようにしてもよい。

【００８０】

【発明の効果】以上述べたように、本発明によれば、駆動用コイルが小型且つ高精度に形成されると共に、十分なモータトルクが得られるようにした、極めて優れた小型モータが提供されることになる。

【図面の簡単な説明】

【図１】本発明による小型モータの第一の実施例を示す一部破断平面図である。

【図２】図１の小型モータの概略断面図である。

【図３】図１の小型モータにおけるステータ基板の製造工程の一例を順次に示す工程図である。

【図４】図３の第一の導電層形成工程で使用されるマスクを示す平面図である。

【図５】図３の通電穴形成工程で使用されるマスクを示す平面図である。

【図６】図３の第二の導電層形成工程で使用されるマスクを示す平面図である。

【図７】図３の給電用電極形成工程で使用されるマスクを示す平面図である。

【図８】図１の小型モータにおける駆動用コイルの結線の一例を示す回路図である。

【図９】図１の小型モータにおけるステータ基板の他の構成例を示す断面図である。

【図１０】図９のステータ基板における駆動用コイルの結線の一例を示す回路図である。

【図１１】図１０の結線によるコイルの等価回路図である。

【図１２】本発明による小型モータの第二の実施例を示す概略断面図である。

【図１３】図１の小型モータにおけるステータ基板の製造工程の他の例を順次に示す工程図である。

【図１４】図１の小型モータにおけるステータ基板の製造工程のさらに他の例を示す断面図である。

【図１５】本発明による小型モータの第三の実施例を示す概略断面図である。

【図１６】従来の小型モータの一例を示す概略断面図である。

【符号の簡単な説明】

１０　小型モータ

１１　ステータ

１１ａ　軸受部

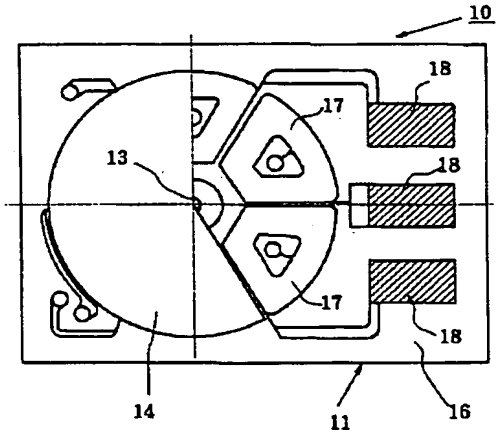
13

12　軸受
13　回転軸
14　ロータ
14a　ロータマグネット
15　ベース
16　ステータ基板
17　駆動用コイル
18　電極
20　絶縁層
21　第一の導電層
22　フォトレジスト
23　第一の導電パターン
24　第二の絶縁層
25　第二の導電パターン
26　第三の絶縁層
30，31，32，33　フォトマスク
40　小型モータ
41　ステータ
41a　軸受部
42　軸受
43　回転軸
44　ロータ

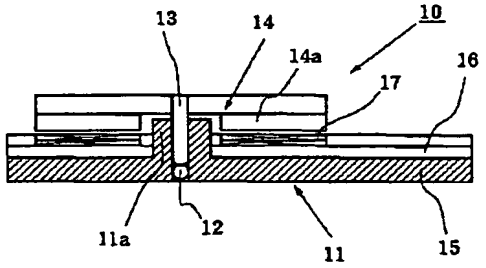
14

44a　ロータマグネット
45　ベース
46　ステータヨーク
47　ステータ基板
48　駆動用コイル
49　磁性層
50　絶縁層
51　第一の導電層
52　フォトレジスト
53　第一の導電パターン
54　第二の絶縁層
55　第二の導電パターン
56　第三の絶縁層
60　小型モータ
61　ステータ
62a，62b　軸受部
63　回転軸
64　ロータ
64a　ロータマグネット
65　ベース
66　ステータ基板
67　駆動用コイル

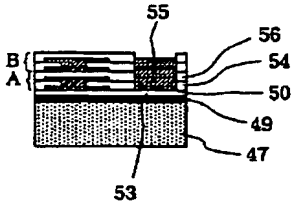
【図1】



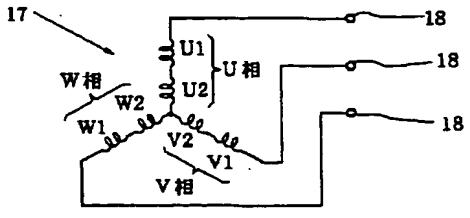
【図2】



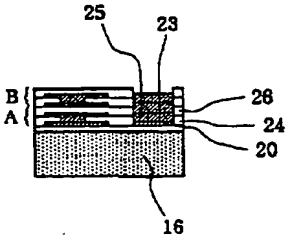
【図14】



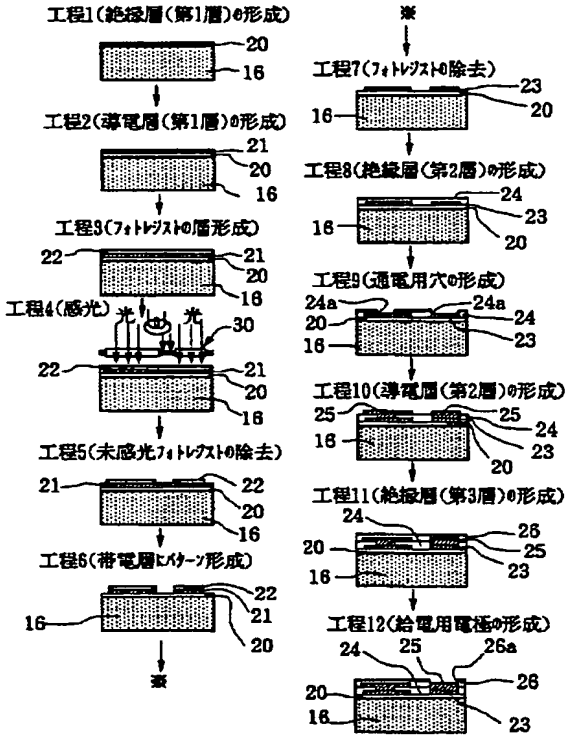
【図8】



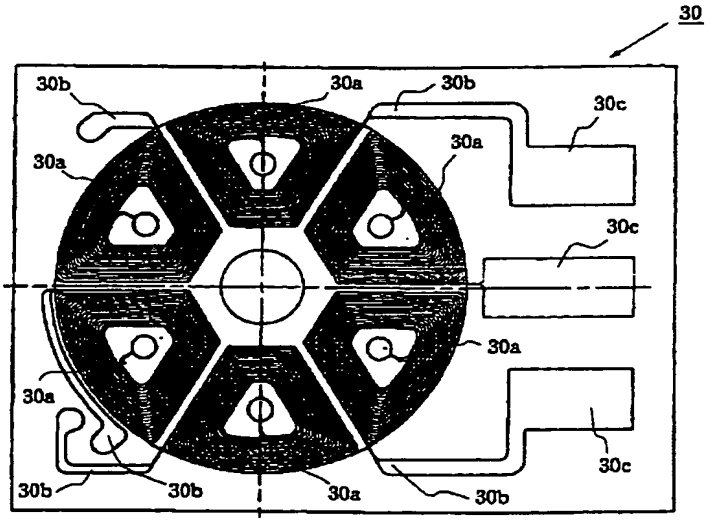
【図9】



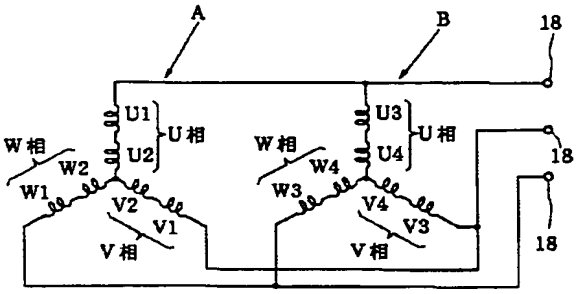
【図3】



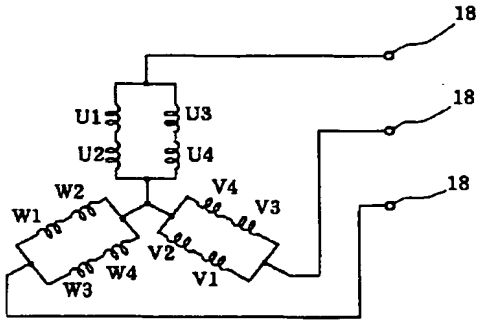
【図4】



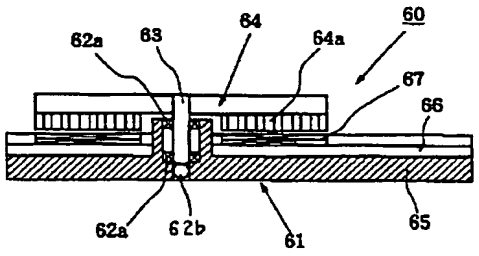
【図10】



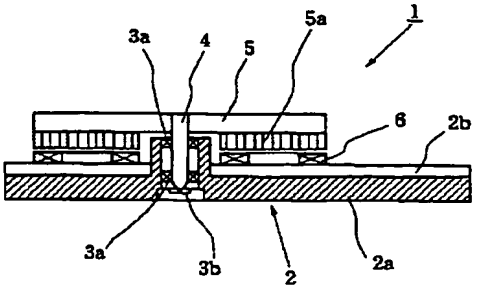
【図11】



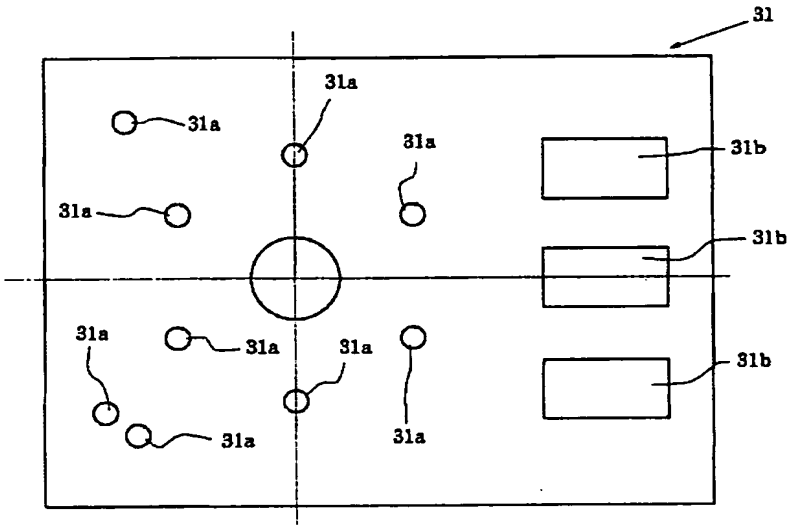
【図15】



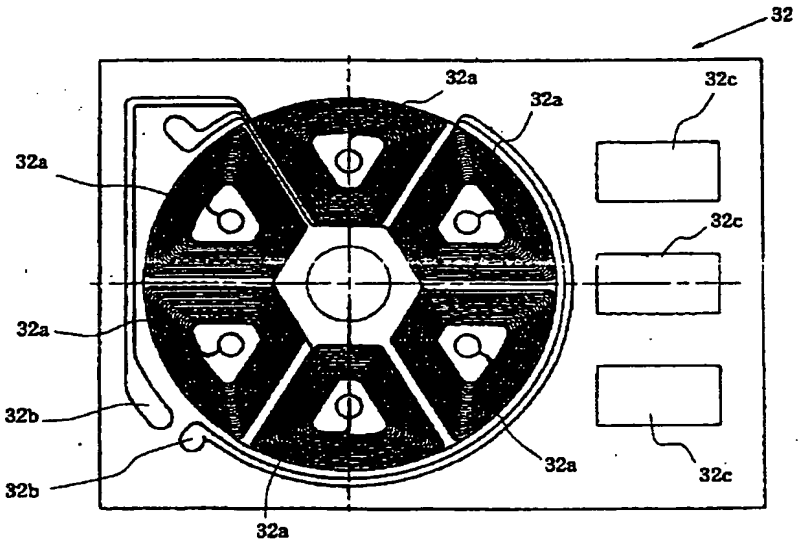
【図16】



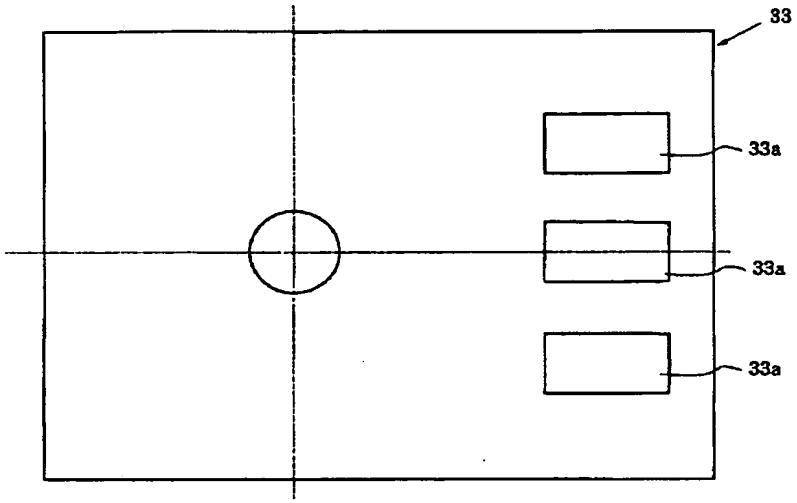
【図５】


31
31a
31a
31a
31a
31b
31b
31b
31a
31a
31a
31a
31a

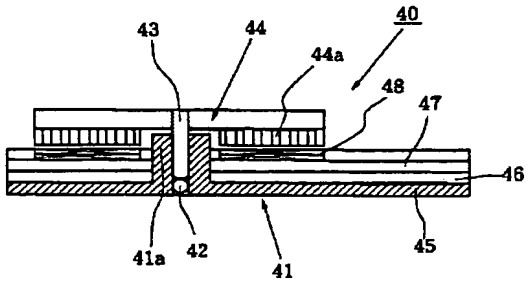
【図６】


32
32a
32a
32c
32a
32c
32a
32b
32b
32a
32a
32c

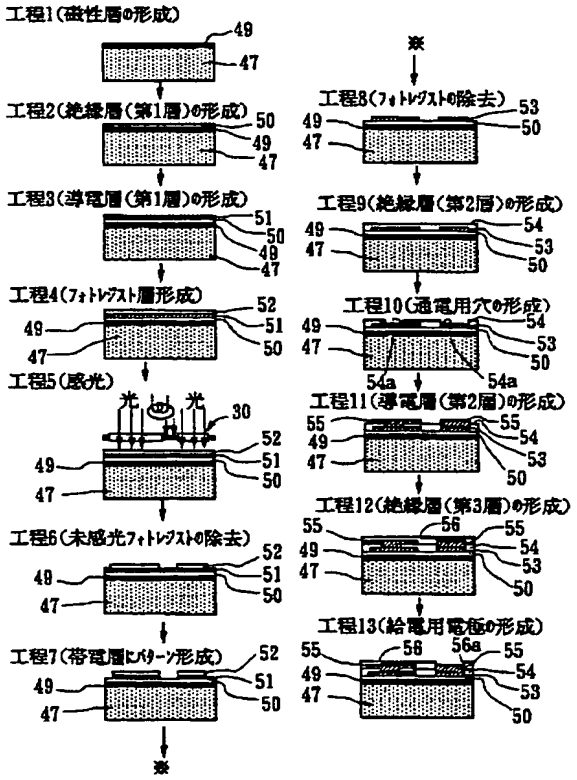
【図７】


33
33a
33a
33a

【図１２】


43
44
40
44a
48
47
46
41a
42
41
45

【図１３】


工程1(磁性層の形成)
工程2(絶縁層(第1層)の形成)
工程3(導電層(第1層)の形成)
工程4(フォトレジスト層形成)
工程5(感光)
光
光
工程6(未感光フォトレジストの除去)
工程7(導電層にパターン形成)
※
※
工程8(フォトレジストの除去)
工程9(絶縁層(第2層)の形成)
工程10(通電用穴の形成)
工程11(導電層(第2層)の形成)
工程12(絶縁層(第3層)の形成)
工程13(給電用電極の形成)